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GEOLOGY
Minerals Mines and Soils of
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OF THE COUNTRY
BY
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1857.

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GEOLOGY, MINERALS, MINES, & SOILS

OF

IRELAND,

IN REFERENCE TO THE

AMELIORATION AND INDUSTRIAL PROSPERITY OF THE COUNTRY.

BY

JOSEPH HOLDSWORTH, Esq.,
M.G.S.F., ETC.,
AUTHOR OF "A BATTLE WITH THE BASALTS," PAPERS, ETC., ON THE "CLIMATES
OF EUROPE, AND SOUTH-WEST OF ENGLAND," "GEOLOGY AND MINERAL
RESOURCES OF WALES," "RURAL SCENERY AT HOME AND
ABROAD, WITH REFERENCE TO TRUE TASTE IN
LANDSCAPE EMBELLISHMENT, ETC.

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PREFACE.

WHATEVER may have a tendency to ameliorate the social condition, to advance the domestic interests, or to augment the general prosperity of Ireland, can hardly fail of being hailed with heart-felt satisfaction, not only by its inhabitants, but by all who are solicitous for the due maintenance of the strength and supremacy, of the British Nation.

The primary object, with the Author of the present work, has been, by the faithful exhibition of distinctive natural evidences, to prove that the "Green Isle" is really rife in all the substantial elements, which are so essential to such a desideratum; and that they only require to be known and appreciated by his more wealthy countrymen especially, to insure their effective development, and realise those solid benefits and permanent blessings to mankind, for which they were designed by a wise and beneficent Providence.

Science, as now almost universally admitted, is the handmaid to a proper development of natural phenomena, and to the successful pursuits of practical life; and, in endeavouring to offer a general view of the material resources of the Island, with as much brevity as was consistent with intelligibility, it has been deemed of importance to give an especial prominence to its geological structure, as yet so little known to the general public, and also to show the distribution of the respective formations, those of a metalliferous character, and the localities where mines, or mineral lodes are situated, which, it is trusted, will prove acceptable, not only to the scientific inquirer, but be of much service to the capitalist and mineral explorer.

During the period of the Dublin Great Exhibition, the Author published a brief outline of these geologic features in the Mining Journal; and to which excellent publication he is indebted, in the present instance, for some important statistical information. Although, from the very nature of the subjects treated of, immunity from error is almost, if not wholly unavoidable, the most scrupulous attention has been paid to this highly essential desideratum, in the admission only of such facts, evidences, &c., as have been derived from actual observation, and consulting the most authentic sources of information.

The Author's long and intimate acquaintance with practical geology and agriculture, —and especially his extensive investigations into all that appertains to the former, both at home and abroad,—it is presumed, may be deemed a sufficient apology for intruding the following treatise on public notice; he has, however, been further impelled to the task, by the spirit of inquiry, which has so recently sprung up among the British public, with regard to the material and domestic relations of Ireland, chiefly with a view to investment in the soil or in the minerals.

The character and capabilities of the soil have, therefore, been dwelt upon with some particularity, as also the ferruginous deposits, peat bogs, and climate; and to which has also been added much valuable statistical information, and some few subjects of a perhaps somewhat digressive and speculative, though deeply interesting scientific character, with a desire to awaken a laudable curiosity, and to blend utility with information and amusement.

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GEOLOGY AND MINES OF IRELAND.

CHAPTER I.

IRELAND'S DAWNING PROSPERITY—DUBLIN, GREAT INDUSTRIAL EXHIBITION—IRISH MARBLES—LOCALITIES OF METALLIC MINERALS—GEOLOGICAL FORMATIONS OF WICKLOW—ITS MINERAL LODES, ORES, AND AURIFEROUS DISCOVERIES—GEOLOGY OF THE COUNTY OF WATERFORD—ITS LEAD AND COPPER MINES—GRANITE RANGES OF WICKLOW AND WEXFORD — THEIR PHYSICAL FEATURES—CHARACTER OF THEIR SOILS—DOMESTIC USAGES—CULTIVATION.

ASSUREDLY, a brighter era has dawned upon Ireland. The genial sun of a manifestly providential visitation is now fairly above her horizon; its revivifying rays have already called into life and activity the latent forces of civilization, which have, for untold ages, lain dormant within her prolific womb; they are rapidly dispersing the hitherto stagnant mists, and removing those foul blotches—moral, social, and political, which, during the protracted period of a chastening ordeal, affixed themselves like vampires upon her, to the great exhaustion of the life-blood of her national existence, and to the sad disfigurement of those physical features which Nature herself has rendered so eminently attractive.

For practical illustration of the verity of these reflections, we might triumphantly advert to the striking and elaborate displays, representing the industrial resources of Ireland, in the Great Exhibition, which so recently graced her spacious and handsome capital; and which owed its existence to the munificence of one of the most public-spirited of her sons, —the enterprising and successful Mr Dargan. And, from a lively recollection of the multifarious adornments of that fair temple of industrial knowledge and pursuits, we might, if it were not somewhat foreign to our present purpose, dwell here, in rapturous and protracted detail, on the vast variety and beauty of artistic forms and fabrications, both of utility and ornament, which the skill and dexterity of the native manufacturer had, as with the wand of enchantment, elaborated from the emboweled treasures and rich vegetable robes of the "Emerald Isle;" and we could well ponder, with much profitable and pleasing reflection, on the prosperity and happiness, which a steady and peaceful perseverance in employments so eminently useful and elevating, cannot fail to secure both to its present and future inhabitants. Such exemplifications do, indeed, most palpably justify the opinion, that "there is no want of talent and energy in Ireland, whenever properly stimulated and called on."

A retrospective glance, however, at the mineralogical department of the Exhibition, comes more within the scope of our present inquiries. And we advert to it here, chiefly for the purpose of speaking of the display of Irish marbles; the rare and varied beauties of which, as exhibited in a multitude of polished specimens, elicited universal and unqualified admiration. Tipperary and Kilkenny furnished a black marble, susceptible of a high polish, the beauty of the latter being, in the estimation of some connoisseurs, rather enhanced, than deteriorated, by a spare sprinkling of a large bivalve shell filled with pure white calcareous spar.

King's County and Armagh sent a wavy-red, and often, encrinal marble. There were also the many-coloured of Fermanagh. A grey-clouded marble of great and singular beauty was obtained from Cork and Limerick, as also from the same counties, mottled grey and brown ones, of a very similar kind to some slab specimens, from the quarries of Kerry and Drogheda; while from Connemara—the Irish Highlands—were derived the unique and exquisitely beautiful green marbles, of various shades, and finely grained. It may, indeed, be said, that there is not a county in Ireland, in which marbles of greater or less excellence may not be found, and a choice collection from them would vie with the most esteemed marbles of the Apennines and Pyrenees, and where the author, in all his geological rambles in those Alpine regions, may correctly affirm that he never met with (*in situ*) any marble surpassing in beauty and richness the green marbles of Connemara. We may add, that Irish marbles are now coming into very general use for chimney-pieces, ornamental slabs and tables, door cases, bust pedestals, &c.; the green ones being manufactured even into a variety of fancy articles, as beads, bracelets, watch-cases, &c.; and it is highly probable that as they become more generally known and appreciated they will be largely exported, not only to England, but to the Continent and even America.

Amongst the expositions of native metallic ores, we observed some very fine massive specimens deposited by the General Mining Company for Ireland,* and

---

* Mr Purdy Allen, secretary to the company, shows by the following statistics the annual produce of the mines for the last twenty years:—

Year.	Tons.	Value.		
1834	352	£4,362	16	1
1835	536	5,840	6	5
1836	820	11,506	10	8
1837	1107	11,060	8	11
1838	1045	10,964	17	4
1839	760	7,531	7	7
1840	754	7,641	16	5
1841	608	6,349	13	7
1842	732	7,462	10	4
1843	517	4,796	8	4
1844	418	3,401	5	5
1845	448	4,717	15	5
1846	440	4,670	15	4
1847	445	4,470	14	3
1848	393	3,833	5	3
1849	471	4,203	11	2
1850	592	5,434	3	5
1851	715	8,138	14	9
1852	996	10,127	11	9
1853	932	11,742	11	8

This company has just declared a dividend at a rate of fifteen per cent per annum.

others; consisting principally of argentiferous copper ores, silver-lead ores, and iron pyrites. They were chiefly from the counties of Down, Galway, Mayo, Leitrim, Dublin, Wexford, Waterford, Wicklow, Cork, Limerick, Clare, and Kerry, and were for the most part certainly very striking representations of their respective mineral wealth, but it would be a mere work of supererogation to dwell upon them here, as their several geognostic positions, localities, &c., will come under notice in the sketch we may now proceed to give of the general geological features of the country.

There are four considerable tracts of granite in Ireland. That which we shall first refer to, commences at Kingston, on the southern shores of the splendid bay of Dublin, and proceeds in a southern direction, through the counties of Wicklow and Carlow to near New Ross in Wexford—a distance of sixty-six statute miles. Throughout its main chain it has been designated by Professor Haughton, a "Potash granite," and who also calls that which occurs at Rathdrum and Oulart, a "Soda granite," in being distinguished from the former by a diminution of silica and an increase of lime and soda. It is surrounded by the mica slate and lower Silurian slate formations, with the exceptions of a small breadth of clap or middle limestone reposing on its flanks opposite to Dublin, and a narrow strip of the lower carboniferous limestone, which, near Athy, Carlow, &c., crops out from beneath the Kilkenny coal-fields. This granite district affords excellent white building materials. Indeed, of this granite, a particular vein is worked at the coast village of Bullock, which has been found superior to any other kind of stone for withstanding the wash of the sea, and is held in high repute for the building of the lower stories of those lighthouses which are exposed to the dash of stormy heavy seas. The slate tract occupying the area between it and the Irish Sea produces very good roofing slates.

The Wicklow mountains, including the clay-slate ranges, trend in a S.S.W. direction, from Dublin Bay to the junction of the Suir and the Barrow, near Waterford. The slate rocks attain a somewhat less elevation than the granitic tracts, on which they here immediately repose, and are often considerably distorted and broken at their basset edges. The clay-slate formation imparts a bold and varied aspect to the eastern shores of Wicklow; it is intersected by deep ravines and dells, often bordered by mural precipices, or enclosing romantic expanses of water. The great metalliferous channels are found on the eastern flanks of the granite mountains, while in the clay-slate ranges which border them to the westward, and are of a more rounded and uniform character, few or no metallic deposits of consequence have as yet been discovered. Two or three isolated masses of greenstone protrude through the clay-slate a short distance to the south of Arklow, and a narrow series of such trap rocks may be traced from thence to the Wexford and Waterford coasts, where they occasionally occupy rather considerable areas.

In a metalliferous point of view, the granite tract of Wicklow presents a singular contrast to the granite ranges of England; for it contains lead veins, said even to surpass in richness those of the superincumbent slate rocks! However this may be, it has been well ascertained that both these formations are intersected at their juncture with a great number of lead lodes; traversing them in an oblique N.N.W. and S.S.E. direction; and though they have generally been found most productive in the districts of Glenmalur, Glendalough, and Ballycorus, more recent explorations have proved the existence of valuable deposits of ore, along this eastern boundary of the granite district through Wicklow into Wexford, mainly occurring, however, in the former, through a limited area of the clay-slate formation, extending in length, from the borders of the county at Croghan Kinshela, ten or eleven miles in a N.N.E. direction, and having but a small breadth. Here, are found gold, silver, iron, zinc, lead, tungsten, antimony, arsenic, and manganese.

Van Diemen's Land mine, worked in the upper reaches of Glendalough valley, contains copper pyrites. A capacious and well-defined vein near the Seven

Churches, county Wicklow, has been proved to a depth of 360 yards; it has yielded from three to four and a half tons of galena per cubic fathom, and about seventy per cent of metallic lead. The Luganure mines are wrought by the Mining Company of Ireland, and are often very productive; the lode contains flour-spar, has a course of lead six inches wide, and is worked entirely in granite. The copper pyrites mine of Cronebane has produced from ten to fifteen tons of ore per cubic fathom. The poorer copper ores of this district average four and a half per cent of copper. In the upper grounds of Cronebane native silver has been discovered in a bed of ferruginous ochre. The Ballymurtagh copper-pyrites mines are opposite to Cronebane; these mines were very successfully wrought for copper, in 1755; and considerable quantities of sulphur are now annually extracted from them.

The Wicklow mines have, for the last fifteen years, produced a large quantity of iron pyrites, containing about forty-five per cent of sulphur; the produce has amounted in part of that period to 100,000 tons per annum, and is capable of increase. This ore has been extensively used by the various alkali manufacturers instead of Silician brimstone, and has greatly reduced the cost of the latter. It is now considered an important product, and has been the means of giving employment to great numbers of otherwise destitute persons. If this substitute for Silician brimstone had not been found, that article would now be at an enormous price, instead of from £5 to £6 sterling per ton. Besides iron and copper pyrites, green and white lead ore, and galena, exist in considerable abundance, in various localities, throughout this region of the granitic ranges.

The mines of this mountainous district are chiefly worked by levels, sometimes of great length, and some of which are situated at the height of upwards of 1400 and 1600 feet above the level of the sea. Some thirty mines of copper and about twenty of lead are at the present period in course of working in Wicklow. The Connary mine produces copper, sulphur ore, lead with zinc, arsenic, antimony, and auriferous silver. Particles of gold are found in two or three of the above copper mines. In these days of startling gold-finding, it would be unpardonable to pass over wholly unnoticed the earlier auriferous discoveries of Wicklow. Towards the close of the last century native gold was found in considerable quantities disseminated in the beds of rivulets and streams descending from the Kinshela Mountain, on the confines of Wexford, and about the junction of the granite range with the Silurian slate rocks. A peculiarity has been observed in the Croghan Kinshela granite, which is said to distinguish it from any of the other granitic areas of the surrounding country. It consists of quartz, chlorite, and albite; while the potash granites of the main chain consist of quartz, orthoclase, and margarodite mica.

The gold occurred chiefly in minute grains, but occasionally in nuggets, one of which weighed twenty-two ounces, another eighteen ounces, and others seven, eight, and nine ounces. It was first discovered by the country people, and before the fact became generally known, at least £10,000 worth was calculated to have been disposed of. This was chiefly obtained in the bed and on the banks of the Ballinvalley, or Gold Mine River, a tributary of the Avoca. Subsequently, Government collected in two years 945 ounces, which, however, it is said, barely defrayed the cost of the gold-seeking operations.

It is specially worthy of notice, that the gold was found in an alluvial deposit, (or perhaps rather talus,) composed of the disintegrated debris of most of the neighbouring rocks and mineral lodes, consisting chiefly of fragments of rock, sand, gravel, iron pyrites, red and brown hæmatite, manganese, quartz, wolfram, magnetic iron ore, in masses of considerable size, and even of tinstone, in crystals. Now, as most of these associated fragments can be traced to their sources or parent beds in the Wicklow range, reasoning from analogy, the existence of gold also, *in situ*, in the adjacent mountains would seem almost to amount to a certainty. The nuggets would appear to have been derived from quartz veins or lodes, many of which traverse the clay-slate of this district, whilst it is highly probable that the smaller particles and scales of gold were liberated by the decomposition of the circumjacent granite and Silurian formations. It is now believed that gold is very generally disseminated through the latter series especially. And it has been well remarked, that the vast supply of gold, which has been recently discovered in the sand of rivers, and in the valleys of California and Australia, is an indirect result of the disintegrating influences of air, carbonic acid, and water. This noble metal being scattered in small particles through the substance of various ancient rocks, is at length, by the constant wearing down of the latter, set loose, and is then washed down and borne by mountain torrents to a distance from its original position.

Two nuggets of pure gold were found in the part of Wicklow above referred to, in the course of the past year; the largest, which was discovered embedded in soft clay-slate about one foot from the surface, on the estate of the Earl of Carysfort, is said to have weighed about two pounds troy. There is abundant evidence that the ancient Irish were acquainted with the sources of native gold; and from this fact, coupled with the character of its more modern discoveries, it is surely not too much to infer that when the present spirit of enterprise and searching appliances of science are brought fairly to bear on its development, we may expect, perhaps ere long, to see even native gold assuming a position of some importance amongst the industrial resources of Ireland.

Proceeding through the southern divisions of the country, we find a considerable development of the lower Silurian rocks in Wexford and Waterford; those of the latter county being bordered on the north and west by the Old-red-sandstone, and to the south partially by the trap-rocks already referred to. The county of Waterford contains some of the highest and wildest mountains in Ireland; they are sometimes constituted of two varieties of slate; the newer slate rests upon the old grey transition slate, which is extensively used for roofing; the lower divisions of the more ancient formation consist of alternating strata of brownish and quartzose conglomerate, and coarse red slate and sandstone, which may be seen extensively developed along the shores of this county and Cork, and which there passes into red-purple and grey clay-slate, the whole series forming boldly projecting headlands, or numerous sinuous recesses, impending cliffs and deep caverns, together presenting striking evidence of the powerful erosive action exerted on the arenaceous, and still more indurated, strata by the prolonged roll of the huge waves of ocean, and frequently constituting coast scenery, of the most fantastic and romantic character.

The principal, and most fertile, valleys of this part of the country are occupied by limestone; they intersect the bold elevations of the old-red-sandstone formation in a nearly east and west direction, usually, as in the case of the beautiful Blackwater valley, terminating in the sea. In some of these and the clay-slate tracts, chiefly near the coast, several valuable copper and some lead mines have been discovered. At Bonmahon, where a narrow strip of clay-slate intervenes between the basaltic range and the sea coast, the mines are of a very productive character, and have been valued at upwards of £40,000. The principal lead lodes run in the direction of about twenty degrees south of east, and dip towards the north. The copper lodes, filled chiefly with a quartzose matrix, commonly produce grey copper ore, or sulphuret of copper and native copper. The former contains about eighty per cent of copper, and twenty of sulphur. There are twelve mines of copper, four of lead, and two of iron reported, as now in full operation in Waterford and Wexford. Cobalt, zinc, grey ore of antimony, and arsenical pyrites are also found here.

From the hills of Crauagh, and on the shores of Kilmurrin considerable quantities of silver have been procured. Large quantities of slates are raised from the quarries south of Lismore. The Knockmahon mines consist of rich copper and silver-lead ores; they occasionally make large returns, and sold 505 tons of ore, in the month of May 1855. Iron is found at Drumslig and Carrick-on-Suir; and lead on the coast opposite Youghal, and in the parishes of Carrick and Enniscorthy. The mines of Knockatrellane, Seafield, Kilminnin, Killelton in Waterford, and Kerloge in Wexford, consist of copper ore. The trappean rocks, as above intimated, are somewhat extensively developed, (in the vicinity of the copper mines), in the south-east district of Waterford.

In the Wicklow division of the granitic and slate ranges under consideration, there are several mountains varying from 2000 to 3000 feet in height, and many others from 1000 to 1900 feet high; thus imparting an extremely varied aspect to a very extensive tract of country, and often constituting scenery of the most romantic and delightful description, especially in its numerous wooded glens and defiles, the more celebrated of which are, the Glen of the Downs, the Devil's Glen, the Dargle, Glencree, Glencullen, Glenmalure—of superior beauty, the Glen of Imail, Glendalough, the vale of Avoca, or the "meeting of the waters," and others, all much frequented by tourists.

Several fine lakes are interspersed about these localities, which greatly contribute to the picturesque character of the scenery, and afford ample amusement to the angler. The principal lakes are Lough Dan, Glendalough, Lough Bray, and Lough Tay, the latter being considered one of the most picturesque spots in Wicklow. The natural beauty of the numerous landscapes of lake, glen, and cliff, to be met with in this mountainous region is frequently enhanced by extensive plantations, or woods of mature growth, clustering about the winding defiles or ascending their precipitous slopes. The maritime district, extending from Bray to Arklow, merits especial notice for its verdant beauty and fertility. Kilruddery, the seat of the Earl of Meath, a fine Elizabethan edifice, adorns the precincts of the former town; whilst in the neighbourhood of the latter, on the banks of the lovely and romantic Avoca, are situated the mansions and finely wooded demesnes of the Earl of Wicklow and the Earl of Carysfort, which, together with the many prettily sequestered residences scattered about the undulating coast, afford a pleasing and interesting series of sweetly rural views, occasionally relieved by the bolder features of the Wicklow ranges, and of which, the Sugar Loaf Mountain and the towering promotory of Bray Head, here constitute very conspicuous and interesting objects. About four miles distant from this shore are the extensive banks called Arklow sands, which are in high repute as valuable and abundant fisheries.

Extensive turbaries, and heather, cover the more elevated mountain ridges, but the vast slopes generally afford excellent pasturage for sheep. The soil of the whole district varies much, and is chiefly devoted to agricultural purposes. That of the lower tracts, and bordering the rivers, is very fertile. Considerable breadths of wheat are grown, but oats and potatoes are the principal crops.

As a peculiar geological feature of the neighbouring coast, we may here observe, that immense beds of marl, containing shells of northern latitudes, stretch along it, from Dublin—by the Wexford and Waterford shores—as far as Cork. In the interior, even amid the wild and lofty Cummeragh mountains of Waterford, the deep alluvial mixed deposits of fragmentary limestone, sand, marl, &c., which so extensively form the banks of rivers, and skirt the mountainous ranges, are for the most part very productive, and the clay-slate tracts, where the strata are moderately inclined, and where they are bordered by the limestone, granitic, or more especially trap rocks, also afford a very excellent soil; the decomposition of the several formations, liberating a number of elements which, for the most part, mechanically or chemically, and in due proportions, are so essential to the healthy and vigorous growth of vegetation. Top dressings of lime are extensively and most beneficially resorted to, in the slate districts of Wexford;* and in which county, a better soil is found on the granites, (by the disintegration of the felspar, which contains a considerable amount of

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* The analysis of the Wexford clay-slate, according to Mr Antisell, is as follows, in 100 parts:—

Silica	68.0
Alumina	14.0
Oxide of Iron	7.0
Carbonate of Lime	1.2
Traces of Magnesia, &c. Alkaline, Chlorides, Sulphates	8.0
Organic matter, water, &c	6.8
	100.0

potash), than is afforded by the northern or Dublin termination of the range, owing to silica being the predominant element, which renders the rock less amenable to the decomposing agencies.

In the county of Wexford, the unimproved tracts of peat-bog and mountain, are of but limited extent, as compared with the cultivated lands. Very considerable tracts of the latter consist of cold clayey soils, but are rendered tolerably productive by the application of lime and a very creditable system of tillage, the happy results of which, are even more apparent, in the for the most part calcareous, cultivated tracts of Carlow, Kildare, and Queen's County, where, as in some other of the neighbouring districts, stock, implements, rotation of crops, and the industry with which manure is collected and compost manufactured, there is a great and increasing improvement.

Most of the waste lands of this region might be reclaimed with very great advantage; and, for which, the varied and peculiar character of the geological formations comprising its surface, frequently afford rare facilities; the landlords, however, generally speaking, evince but little or no disposition to render any efficient aid towards such desirable improvement, and such undertakings are usually of too formidable a nature for the limited means of the tenantry, however beneficial the result to their vital interests. On the plains, as well as on the mountain ranges, there are extensive sheep walks; of the former, the Curragh of Kildare—the New Market of Ireland—claims especial notice; it consists of 3000 acres and extends six miles between the towns of Kildare and Kilcullen. The soil of the surrounding district, chiefly arable, is a rich loam, with substrata of floetz limestone, or clay-slate, and produces abundant crops of barley, wheat, oats, and potatoes. On many properties peat or bog-earth is very commonly used as manure.

Farms in the above counties, as in Wexford, run from ten to fifty and sixty acres, but farms of thirty and forty acres are the most usual. "The people of this country, generally," says Mr Inglis, "are said to be a money-getting people; and in the system which prevails extensively with regard to marriages among the rural population there is considerable evidence of this. The disposal of farmers' daughters is matter of regular traffic, acre for acre, or pound for pound; and so great is the difficulty of marrying girls without portions, that it is no unusual thing to find families, who are in comfortable circumstances, living as poorly as the common labourer, or the rack-rented tenant of a few acres, in order that they may save a few hundreds for fortuning off their girls." He also observes that, "in the husbandry of the district, there was every thing to recommend. The land was well laboured and cleansed; the crops of wheat and beans—the cultivation of which is extensively pursued here—were excellent; and a serviceable plough, with two horses and one man showed some knowledge of the economy of labour."

The more elevated, Devonian or arenaceous, tracts of Waterford, consisting of silica in fine grains, and occasionally of a conglomerate character—coloured yellow or red by variable quantities of peroxide of iron—generally afford soils of a coarse description and middling quality, especially where the country is seen swelling into lofty, craggy hills; but many of the long, wide, winding valleys, so characteristic of this part of the country, are marked by much fertility, and a more effective system of culture prevails, particularly in the estates of the resident gentry, and on the very extensive properties of the Marquis of Waterford, Duke of Devonshire, and Lord Duncannon, for the most part situated in the neighbourhood of the city, as also on those of the Earl of Fortesque, stretching far along the rocky and sinuous coasts. Even the mountainous parts of Waterford afford good pasturage, and it is the chief dairy county in Ireland.

CHAPTER II.

OLD RED SANDSTONE FORMATION—CARBONIFEROUS LIMESTONE—UPPER CLAY-SLATE—VALUE AND CHARACTER OF THEIR METALLIFEROUS DEPOSITS—MINES AND MINERAL LODES OF CORK—LIMESTONE CAVERNS, SOILS, &c., OF CORK—CAHA MOUNTAINS—SILURIAN SERIES—MINES NEAR BANTRY BAY AND LAKES OF KILLARNEY—GEOLOGICAL STRUCTURE OF KERRY—FLOETZ LIMESTONE—ANCIENT IRON WORKS—MINES OF KENMARE VALLEY—SCENERY OF KERRY—ITS AGRICULTURE—LANDLORDS AND PEASANTRY—CORK AND BANDON RAILWAY—UNRECLAIMED LANDS—BOG OAK.

THE lower Devonian, or Old-red-sandstone formation, constitutes an extensive, and often very picturesque, tract in this part of the country, occupying a great portion of Waterford and nearly the whole of the county of Cork, extending even to Cape Clear, and mainly forming the romantic borders of the noble Bantry Bay. The upper divisions of this formation occupy an extensive district around Bandon. The country where its lower strata predominate is occasionally, singularly intersected by long narrow tracts of the lower and upper carboniferous limestone, as from Mallow to Dungarvon, Cork to Youghal Harbour, &c. The former, or limestone of the Blackwater valley, extends northward to Charleville, Tipperary, &c., and westward by Fermoy to beyond Mallow, where it immerges beneath the Munster coal measures, and in the opposite direction reposes on the northern flanks of the Devonian and Silurian formations, which constitute the bold mountain groups of north-western Cork, and the lofty ridge separating that county from Kerry. The mines wrought in this extensive region are both numerous and important; in fact, the copper mines of the southern mountainous tracts of Cork are sometimes singularly rich and productive. The lodes are found intersecting both the Old-red-sandstone and adjacent limestone, and frequently affording very valuable deposits of copper ore. Indeed, it has been officially affirmed, as a fact, which the Swansea sale lists prove, that the copper ores found in the mines of Cork are among the richest in the world; are nearly twice as rich in the quality of their produce as the richest copper mines in the world, and more than twice as rich as the richest copper mine in Cornwall.

Perhaps in no part of the British Isles is the enterprising spirit which now actuates the mining world, much more manifestly exhibited than it is at the present period, in the discovery and development of mineral riches, over nearly the whole of the broad coast line we have thus far geologically delineated, and especially that portion of it constituting the southern division of the county of Cork. Upwards of thirty copper mines, several of lead, and a few of iron, sulphur ore, and manganese —the true peroxide—are already in operation. In fact, they here and there stud this part of the country even down to the extremity of that Old-red-sandstone peninsula which stretches farthest out into the vast Atlantic; for here, on the shores of the Crookhaven Harbour, a place of considerable resort for small craft, are situated the famous purple copper ore and silver-lead mines of that name.

The picturesque districts bordering Bantry Bay, and adjacent rocky promontories and islands, have of late years acquired considerable notoriety, from the number and attractive character of the metalliferous lodes, more or less intersecting them, chiefly in an east and west direction. Many of these lodes have been wrought with considerable vigour and varying success. The mines of Cosheen, Dhurode, Horse Island, Kilbarry, Cappach, Crookhaven, Audley, and Irish consols may be mentioned as notable examples. These ordinary ore-bearing veins are frequently intersected by well-defined cross-courses, running north and south, which, however, until very recently have received but slight attention from the mineral explorer. They are sometimes observed, as in the neighbourhood of Ballydehob, in the character of immense quartzose lodes, carrying, not unfrequently, a ryder of specular iron-ore, or occasionally glittering with grey-blue carbonates of copper, and purple copper ore, diffused throughout courses of a whitish killas. These indications, sufficiently tempting of themselves in the estimation of the miner, have induced partial trials, which but too often proved abortive, mainly, it is contended, and as would now appear, from not having tested these north and south lodes to a sufficient depth.

Mr Hoskin, an experienced mine agent, in the course of some protractedand careful examinations of the Cork metalliferous districts, having frequently observed that these large quartz lodes, at their outcrops on the sea-shore, had a much more promising appearance in their lower divisions, came to the conclusion that in order to reach any remunerative deposits of copper-ore, it would be necessary to sink to much greater depths in them than had as yet been attained, and it appears that the Mining Company of Ireland, acting on this suggestion, have recently sunk their mine at Kilkoe, near Ballydehob, through thirty-five fathoms of quartz, when they came upon a rich vein of copper, from seven to ten inches thick, with every indication of increasing richness. This somewhat startling discovery in the profound depths of a north and south quartz lode, is certainly fraught with very important considerations, in a general sense, as to the metal-bearing character of such quartzose channels, abounding, as they do, not only in and about West Carberry, but in many of the metalliferous districts of Ireland, particularly in the vicinage of its western coasts. Should a series of such experiments as the above cited be attended with any similar satisfactory results, they would certainly open up a novel and vastly extended field to the adventurer, whose preliminary trials however, it is hardly necessary to observe should, in all purely speculative cases especially, be duly characterized by circumspection, skill, and perseverance, alike indispensable to the success of all mining operations.

As considerable diversity of opinion exists respecting the metalliferous character of such veins as we have just adverted to, and as modern enterprise, with all its wonder-working appliances, has done as yet but little or nothing towards the actual solution of a question so pregnant in its consequences, we may be excused quoting the opinion of an old, though eminent practical authority on such subjects. Williams, in his "Mineral Kingdom," after stating that he has frequently traced hard quartz veins for two or three miles in mountainous rocky countries, and very commonly observed ores of lead or copper on their surface, says, that on account of their excessive hardness it rarely happens that any trials are made in such veins, unless the ore be found at once at the surface in sufficient quantity to be worth working, and that, therefore, "most of our very hard quartz veins remain entire, for the use of future generations, when our mines which are easily worked are either exhausted, or too deep for draining out the water; as I have no manner of doubt that there are valuable treasures in many of these veins lodged at different depths, in some near the surface, and in others farther down; and in general we are assured from experience, that the farther down the better for plenty of good ore."

The copper mines, in the upper slate (red-micaceous and calcario-slaty beds), and carboniferous limestone in the neighbourhood of Castletown and Berehaven, are said to afford employment to some 2000 persons. In April and May of the past year, 305 tons of copper ore were sold from Berehaven mine. These mines are situated on the coast, "west of Glengariff," in a wild and primitive district, abounding in romantic and picturesque scenery. It is rife in promising indications of metalliferous deposits. Specimens of asbestos have been procured at Berehaven. Veins of sulphate of Barytes occur near Bantry. Also, the argentiferous lead mines of Killinogue, which produce forty-one ounces of silver to the ton. The Dhurode mine, in West Carberry, is spiritedly worked, and produces considerable quantities of copper ore. The striking eminence called Sugar-loaf Mountain, overlooking Glengariff Bay, is intersected by numerous lodes of lead and copper, and contains beds of specular-iron ore and manganese.

There are some other valuable copper mines at Crookhaven, Skibbereen, Ballydehob, and many other places along the indented shores of Cork; the ores consist of purple, yellow, and grey copper. The well known Allahies copper mines, in the vicinity of Berehaven, were first worked in 1814; the grey ore contains from fifty-five to sixty-five per cent. The ashes of a bog, in the same neighbourhood, impregnated with copper, yielded a considerable profit until burnt out. The most productive mines of this part of Ireland are generally found in the reddish, slateform, micaceous strata below the carboniferous limestone, and belonging to the lower Devonian system. Singular inversions of these strata may not unfrequently be observed in the vicinity of the coast, &c.

The carboniferous limestone of the northern districts of Cork, contains some remarkable caverns, and of which, the Mitchelstown cave, discovered in 1833, is worthy of special notice. "The entrance is about midway up a grey limestone eminence, which rises about 100 feet above the level of the mail road. Those persons who visit the cave provide themselves with a suitable dress, and lights are kept in an adjoining public house. Nothing can exceed the beauty of the fantastic forms which the spar has assumed in its descent from the vaulted roof, and no description—not even drawings—can convey any adequate idea of this extraordinary production of nature, which must be seen to be appreciated. The prismatic blocks, in many instances, unite with the stalactites, and form the most graceful pillars, while the crystallizations along the walls assume the soft folds of the finest drapery." It requires two hours to inspect these caves in the most superficial manner. They are situated on the noble demesne of the Earl of Kingston, as also, the adjacent well-known cavern of Skeheewrinky. Their site is denoted by two small round hills of compact grey limestone, and they are nearly equidistant from Clogheen, Cahir, and Mitchelstown.

The soil, as well as the general configuration of the surface, of the greater portion of the county of Cork, closely resembles that of the old-red-sandstone districts of Herefordshire and Devon, and, like them, affords good corn and dairy land. But on its various elevated ranges, running nearly east and west—especially where they assume a still bolder and schistose character on its western limits—the general aspect of the scenery is bleak, barren, and sometimes wildly magnificent This is particularly characteristic of the vast mountain range lying between Bantry and Kenmare. The romantic vale of Glengariff, about eleven miles from Bantry, and the deep winding rocky defile of Kaimaneigh, near that place, are amongst the most singular and picturesque in Ireland.

The soil of these wild districts is generally thin and poor; in the lower grounds many extensive bogs exist, but for the most part, they are susceptible of culture. The widely extended undulating tracts are greatly varied with pasture, moorland, and tillage. And many of the larger valleys are remarkably fertile and verdant, and occasionally, richly adorned with thriving plantations and hanging woods. Mr Inglis, in speaking of one of these vales—the Blackwater—says, "There is here every combination that can be produced by the elements, that enter into the picturesque and the beautiful—deep shades, bold rocks, verdant slopes, with the triumphs of art superadded, and made visible in magnificent houses and beautiful villas, with their decorated lawns and pleasure grounds." Several miles to the north of this vale, opposite Mallow, we find a fertile and populous country surrounding Charleville. Cerial and other crops are here extensively grown, and a good system of husbandry may be said very generally to predominate. This agricultural district constitutes a considerable portion of one of the expansive valleys which traverse the great mountain chain stretching westward, with the single exception of the Blackwater, to the sea at Helwick Head.

The soils of the valleys and glens so numerously intersecting the arenaceous ranges of southern Ireland, are often invested with an extra fertility, owing to calcareous ingredients derived from the limestone rocks which occasionally occur in their vicinity. Indeed, when the soil of the red-sandstone formations contains a proper portion of calcareous earth, it may rightly be considered among the most productive of soils; and where this is wanting, the addition of chalk or lime is the best means of improving it. Lime is greatly used as a manure in the northern districts, and the neighbourhood of Cork; the value of a barrel of lime, throughout the county, is stated to be elevenpence. According to the Ordnance Survey, this finely diversified province has an extent of 1,725,100 statute acres, of which, 1,024,340 acres are available, and 700,760, were in 1840 either bog or barren mountain.

The Old-red-sandstone tract is bordered to the westward by the Caha Mountains, which are chiefly composed of clay-slate, belonging to the upper Silurian series; and this range of mountains is said to embosom as many lakes as there are days in the year—a significant fact for the miner as regards water power. This slate formation constitutes a very wild and extensive tract of country; it stretches out between Kenmare River and Bantry Bay far into the Atlantic. On the north, it skirts the Lakes of Killarney, contributing largely to their celebrated scenery, and passing from thence, traverses the southern parts of county Kerry to Dingle Bay, appearing on its opposite shores, in conjunction with the old red sandstone, and which, near the head of the bay, is overlaid by the carboniferous limestone. The whole area, comprising these formations, may be said to be more or less metalliferous, and remote though it be, several valuable lead and copper mines are already being worked upon it; some such have recently been opened in the neighbourhood of Bantry Bay, which is skirted by a belt of the lower Devonian rocks. Some few productive copper mines have long been wrought about the Lakes of Killarney, especially one in Ross Island, which also produced much cobalt, the abundant produce of ore from the mine averaging about £20 per ton.

In some parts of Kerry, "the geological structure of the chief mountain chains is of red and grey conglomerate and sandstone supporting siliceous flags, overlaid in the low districts by floetz limestone. The principal limestone fields are in the valleys of the Teale, Maine, and Roughty; but the most extensive limestone formation extends a distance of thirty miles, from the magnificent caves in the cliffs near the sea-bathing village of Ballybunnion to Baltard Point in Clare County. The Glanbetry mountains abound with iron ore, which was formerly smelted at Blackstones in works erected by Sir William Petty, ancestor of the Marquis of Landsdowne, but given up in 1750 on account of the deficiency of timber. Iron was also smelted at Killarney, which was noted for its mines even in the ninth century. Copper mines are in occasional operation at Mucross Island in the lower lake. Lead ore has been found in the vicinity of the lake, and copper ore has been found at Ardfert, and in Glanerought Barony. The copperas works near Castle Island are now relinquished." Near Ballybunnion, county Kerry, the anhydrous peroxide, or specular iron is found. This ore contains seventy per cent of metal, and is the richest of any of the ores of iron; it is not unfrequently met with associated with ores of copper and manganese, as at Cosheen, Skibbereen, and other places in Carberry, and it is not uncommon in Kerry.

The Kenmare valley is intersected by several very promising copper and silver-lead lodes, in some of which, mining operations are at the present time in progress. The former lodes occur mainly in the red slate, and the latter exclusively in the superior beds of the lower carboniferous limestone. Nodular iron-stone and pyrites is of common occurrence in the calcario-argillaceous slates, &c., of this vicinity.

The Ardtrilly copper mines of this valley have been in operation, with more or less success, since 1838, and give employment to upwards of 100 persons. The levels extend from east to west, and are about 150 yards in length; the lode is partly in limestone, and varies from four to five feet wide, slightly underlying to the north. The purple and ordinary yellow copper ore occurs in the mines of this neighbourhood. The lead ore, raised on the Godfray estate, Castlemaine, contains eighty-two per cent of lead, and forty ounces, sixteen dwt., of fine silver to the ton. The Ardtrilly, Carrigerohane, and Lissooleen mines consist of copper and lead. Large quantities of slates and slabs, of a superior quality, are obtained from the well-known slate quarries in Valentia Island. They are the property of the knight of Kerry who has a residence in the island.

The scenery of Kerry is characterised by a grand succession of mountain ranges, often of very considerable altitude, and great ruggedness of outline; some of them stretch out into the Atlantic as bold promontories, and others enclose deep romantic valleys containing extensive morasses, constituting, on the whole, some of the wildest and most picturesque scenery of the island. The peaked grotesque fronts of the Magillicuddy Reeks are striking examples of that solitary, gloomy grandeur which characterises many of the mountainous parts of Kerry, with their dark treacherous morasses and long stretches of heather. Carran-Tual, situated in the north of the county, and a few miles to the south-west of the lower lake of Killarney, is 3400 feet high, being the highest mountain in Ireland.

The cultivated, and the unimproved tracts of mountain and bog, are of nearly equal extent in this remote and secluded region. Where highly inclined strata of clayslate, &c., rise to lofty elevations, and which frequently occurs over extensive areas, but a poor and scanty herbage prevails, and this often gives place to a covering of furze, heather, or copsewood; contrasting, however, finely with the denuded and rugged rocks around. But where the stratifications are more horizontally disposed, or are concealed by thick accumulations of debris, often derived from formations greatly varying in their mineral constituents, a very improvable, and not unfrequently fertile, soil predominates. The lower slopes and skirts of mountain ranges present many very pleasing exemplifications of this description. An adhesive loam prevails in the south-western district, whilst the middle district is a rich loam, which produces excellent crops of grain, and yields butter of superior quality, when laid down in pasture. A stiff retentive soil characterises the north and north-eastern divisions of Kerry, which is almost entirely occupied by strata of the Munster coal district.

The wilder tracts, above referred to, would appear to comprise the kind of land which Mr and Mrs S. C. Hall, in their excellent work on Ireland, allude to, when they tell us, that in their presence a peasant addressed his landlord—"*If ye plase yer honour, I want thirty shillings worth of mountain.*" "We were informed," say they, "that the quantity allotted to him for this sum was thirty acres, for a period of thirty years. The labourer sets to work with his spade and *four bones,* picks out every morsel of soil he finds enclosed by rocks, clears it of stones, gradually conveys manure to it, and in the end plants it with potatoes. Nothing in Irish scenery is more striking than such patches of cultivation up the mountain slopes. But an Irishman will endure any privation to obtain a *bit of land*, and suffer any misery to retain it; several of the mountains, however, have been taken possession of by wanderers, distinguished as *squatters*. Any attempts to dispossess them would be dangerous to a degree; they usually mark the boundaries of their *properties* by lines of stones, and are peculiarly jealous of the incoming of a new settler." The following remarks by the same authors so faithfully exhibit the general characteristics of the districts under consideration, that we cannot pass them over in silence:—"The entrance to the county of Kerry, the *kingdom of Kerry*, as it was anciently called, from that of Cork, is through a tunnel of about 200 yards in length, a very short distance from which are two others of much more limited extent. As the traveller emerges from comparative darkness, a scene of striking magnificence bursts upon him, very opposite in character to that which he leaves immediately behind; for while his eye retains the rich and cultivated beauty of the wooded and watered glen, he is startled by the contrast of barren and frightful precipices along the brinks of which he is riding, and gazes, with a shudder, down into the far-off valley, where a broad and angry stream is diminished by distance into a mere line of white. The road, of which there is a view almost the whole way to the Kenmare river, is a gradual descent, so admirably constructed, and kept so carefully in repair, that it is smooth and finished enough to be the entry to a demesne, and is classed by universal consent among the best roads of the kingdom. The whole district, we believe, belongs to the Marquis of Landsdowne, and a better ordered estate, or a more flourishing tenantry, are not to be found in any mountain district of Ireland. Such was not always the case; at one time it was proverbial for the poverty of the land and the wretchedness of its inhabitants. The misery of the soil has been illustrated by a saying, that "a Kerry cow never looked up at a passing stranger, *for fear it would lose the bite.*"

The unreclaimed lands of this extreme south-western division of Ireland are, for the most part, highly capable of agricultural improvement; and should the Cork and Bandon extension railway be carried out as proposed, it would—by giving easy access to the various natural appliances of the neighbouring districts—afford the greatest facilities towards the accomplishment of so desirable an object. The innumerable inlets, bays, and harbours, which here indent a very extensive line of coast, abound with a most valuable shell sand, which, as an agent for the reclamation of peat soils and moor lands, is unequalled, but at present rendered comparatively useless to the farmers of the interior, owing to the heavy expense of land carriage, but which, it is believed, the railway would obviate to an extent of not one-sixth of the present cost, and from the high estimation in which it is held as a manure, would soon become one of the most important articles in the traffic of the extension line. As the sand on most parts of the coast is more or less calcareous, not uncommonly containing sixty per cent of carbonate of lime, it might also thus become a very valuable boon to the Kerry farmer. It has long been used as the principal manure on extensive tracts of land in the vicinage of the sea-shore; indeed, the economic value of lime, as applied to ferruginous soils, and such as abound in inert vegetable matter, can hardly be overrated; it neutralizes the effects of certain injurious compounds of iron, serves to liberate potash from the insoluble silicates of that base, and promotes the decay of vegetable matter.

The farmers and peasantry of Kerry exhibit much ingenuity in the variety of domestic purposes to which they turn the Bog Oak, so abundant in their extensive Peat Mosses, and which, under more favourable auspices, might become a source of very considerable commercial importance. The Great Exhibition contained a striking variety of exquisite articles of *vertu*, manufactured by the natives out of this well-known commodity; as also Arbutus-wood ornaments—a shrub which flourishes most luxuriantly in the vicinity of the charming Lakes of Killarney.

CHAPTER III.

GREAT COAL TRACT OF MUNSTER—COAL DEPOSITS OF KILKENNY, AND THEIR NATURAL BOUNDARIES—BOG IRON ORE—CLAY IRON STONE—ARIGNA IRON WORKS—IRON ORE OF LOUGH ALLEN—IRON ORE OF LEINSTER COAL TRACTS—QUEEN'S COUNTY COAL TRACTS—CORK ARGILLACEOUS IRONSTONE—ANCIENT "BLOOMERIES"—ESTIMATE OF COAL IN LEITRIM—IRON ORE OF THE ISLAND ABUNDANT—PEAT TURF AS A SMELTING FUEL—SUPERIOR IRON—METALLURGICAL INVESTIGATIONS—IMPORTANT DISCOVERY IN THE PRODUCTION OF STEEL—STATISTICS OF THE IRON TRADE—GREAT IMPORTANCE OF ITS INTRODUCTION INTO IRELAND.

IMMEDIATELY to the north of the Silurian and Devonian rocks of Cork and Kerry, we encounter the great coal field of Munster, which, from the effects of denudation, as it would seem, is comprised wholly, or mainly, of the lower members of the coal-formation series of strata, with occasional beds of anthracite coal, the whole reposing on the millstone grit and upper limestone. This carboniferous field occupies a very considerable portion of south-western Ireland, constituting two vast irregular areas, north and south of the estuary of the Shannon, together occupying parts of Cork and Kerry, and extending from Killarney through the western part of Limerick and Clare, nearly to the offing of Galway Bay, where it terminates in the cliffs of Mohar, some eight hundred feet in height.

In the Clare division of this extensive coal tract, some seams of importance are known to exist; as at Carrigaholt, Loughill Ferry, and Fieragh Bay, where they appear in the beds of streams; and another stratum of coal, three feet thick, may be seen in the face of a range of rocks above Liscanor Bay, near Ennistymond. The coal of this district is usually more of a bituminous quality, than any other found in Munster. The anthracite of the Provence, commonly occurs in indurated shaley strata, and sometimes constitutes beds of considerable thickness; 25,000 tons annually have been produced by the largest collieries. In the vicinity of Kanturk, county of Cork, coal and culm have been wrought for near a century. The Dromagh collieries, on the north bank of the Blackwater, are of an extensive character; four descriptions of coal have been developed by their operations—the Bulk-bed, the Bath's-bed, the Coal-bed, and Rock-coal.

Anthracite, a mineral charcoal, is slowly combustible, but without flame; its specific gravity is about 1.400; and it contains ninety-six per cent of pure carbon. It has lately risen into repute as a fuel for steam engines. The anthracite of Munster, generally speaking, is difficult of access, owing to the very considerable inclination of its beds.

But the Kilkenny, Leitrim, and Tyrone coal tracts, are respectively of far more ascertained value, and we purpose here, (and elsewhere), making a few general remarks on these and other localities, where the coal beds or the iron ores, are of sufficient commercial importance to merit the attention of the mineral explorer, or the capitalist. The Irish coal-fields contain three principal beds of anthracite, and four of bituminous or flaming coal; the former being raised in the southern districts, and the latter in the counties north of Dublin; they may be said to be seven in number, are of comparatively small extent, with the exception of the first named as in the province of Munster, and all have their natural boundaries pretty clearly defined by the out-croppings of the older formations; as for instance, the millstone grit and carboniferous limestone, the latter of which, in its upper series, completely encircles, with a narrow belt, the coal-tracts of Leinster and Connaught. They usually occupy very considerable elevations in the limestone basins, and extend more or less into the several counties of Limerick, Kerry, Cork, Antrim, Monaghan, Kilkenny, Carlow, Queen's County, Tipperary, Clonmel, Clare, Sligo, Cavan, Roscommon, Leitrim, and Tyrone, or coal Island. Beds and veins of iron ore, often of very considerable extent and value, exist in most, if not all, these districts.

In the Tyrone coal-tract an abundance of brown hæmatite, or bog ore, is found in concretionary masses. It yields about fifty-seven per cent of iron, or from *thirty-five cwts.* of ore, a ton of iron. This valuable ore, when pure, is a hydrate of the peroxide of iron; it is to be met with in almost all deep morasses, and was more largely used than any of the ores in the iron furnaces of former times. Like the red hæmatites of Lancashire, &c., it renders by its richness most efficient service in the smelting of the poorer clay iron-stone of the coal-measures, and vastly improves the quality of the iron. But its several varieties, mainly supply the iron furnaces of Germany and France, where, from its peculiar properties, it is in high estimation for ornamental castings, and the finer fancy articles.

It not unfrequently happens that such ores are extensively formed in many of the morasses of Ireland; the iron, existing in them in a state of hydrate, is carried down through the light surface soil, and when it meets with a more retentive earth beneath, is often deposited in layers, concreting with siliceous particles, and forming the heath-pan or moor-band.

In the coal measure districts of Connaught and Leinster, clay iron-stone—a carbonate of iron, abounds, and is imbedded in the argillaceous shales, in thin layers or nodular masses. It produces from thirty-six to thirty-nine per cent of iron, and is the product which is almost exclusively used in the iron furnaces of England. The coal series of Aughabehy, Carananault, Celtinavena, Gubburrudda, and Derrynavoggy, all situated in one mountain ridge, contain numerous beds of this iron-stone, and which has been largely smelted at the Arigna Iron Works. It is abundant on the eastern shores of Lough Allen, and in the vicinity of the river Arigna. Mr Twigg, in reporting on the universal capabilities of this district, says, "The iron-stone mines have been examined, and the result found extremely favourable. A greater variety of iron-stone I never met with, from which, by a proper admixture, and proper management, I have no hesitation in saying, that pig-iron of 'best mark, and fit for foundry work of every kind may be obtained. The iron mines begin in Rover, and continue for two and a half miles. I measured several of the beds to more than two feet thick in some places, laid bare in the ravines; and in the beds of the Arigna River we can get any quantity at the shortest notice."

The Loch Allen coal, and its concomitant measures, are more analogous to the millstone grit of the north of England, than to coal tracts in general; alternations of slate and sandstone, interstratified with seams of coal, appear very generally in the cliffs, bluffs, and ravines of the higher flat-topped mountain groups, but are, for the most part, absent in the lower ones. They traverse the more elevated portions of the Munterkenny range, and cap the summits of Sliev-an-ieran, Lackagh, and Lugnaculleagh, but would appear to have been swept away, by denudating forces from the intermediate depressions or lower grounds. The southern side of the valley of the Arigna and the Braulieve Mountains, seem to be the great repositories of the workable coal seams, and their associated beds of iron-ore. Coal is wrought on both sides of Loch Allen, and it is well known that much bituminous coal exists in Connaught, but as yet, very few explorations, comparatively speaking, have been made in the province for this invaluable mineral. The richest Arigna iron ore, yields 42.3 per cent. Poorest 37.7 per cent.—Ordinary Staffordshire 28.0, richest do., 40.5.—Brenkburne, Northumberland, nodular 48.62. —Common Welsh, 31.4, best 42.1.—Lanarkshire, blackband 40.0.—Ordinary Glasgow, 31.6, and the average Kilkenny 38.7 per cent of metal. These are all carbonates of iron, mixed with various earthy impurities; on an average, it is calculated, that carbonate of iron forms one-third of the vast clay iron-stone deposits of Great Britain. The richest iron ores are oxides, which are of pretty frequent occurrence, in large, irregular lodes, masses, and courses, in primitive and transition districts.

It will serve to show the high estimation in which these ores are held, espêcially for smelting with the argillaceous iron-stone of Wales, Staffordshire, Northumberland, &c., to state that the total quantity of Hæmatite (red iron ore, sesquioxide of iron; the best yielding from ninety to ninety-five per cent) exported *from the* Ulverstone district, by railway and by sea, amounted in 1854 to no less than 354,685 tons, making, with the amount raised near Whitehaven, and that used in the neighbourhood, a grand total, for the year, from these two localities alone, of 579,924 tons.

The Leinster coal tracts, mainly situated in Kilkenny, Carlow, and Queen's County, and constituting the principal carbonaceous coal district, also afford abundant supplies of clay iron-stone of good quality. Specimens of it from the Castlecomer beds gave 39.7 per cent of iron. In Kilkenny, it appears to be equally rich and plentiful; Mr Tighe, in his survey of that county, says, "We have already seen that the shale covering the collieries contains nodules of iron ore, and this ore is very heavy and rich; but some of the best iron mines lie open to the surface, and form the upper strata of entire hills. Hills of this kind are seen in a north-east direction, from Lady Ormond's demesne, towards the colliery. On the lands of Aghamuckey is a hollow road cut to a great depth through a rich mine of iron; from this place the ore was formerly carried to be smelted at Mountrath in the Queen's County, as long as the timber lasted in the neighbourhood." An important discovery of iron ore was lately made on Lord Carew's property, at Dysart, in Queen's County. There can, in short, be no question but that the iron and coal deposits of this field, only require to be spiritedly and properly developed, in order to render them of great commercial value.

Argillaceous iron-stone is also abundant in the coal series of Cork, and in former times was extensively wrought; and, as showing the importance which has been attached to the productive character of these deposits, we may remark, that, as far back as 1612, the East India Company had iron works on the Bandon, and paid £7000 for a tract of wood for their furnaces. About 1632, the first Earl of Cork possessed 1000 tons of bar, and 20,000 tons of pig-iron, besides 200 tons drawn out and fagotted into rods. Some idea of the value of this may be inferred, when it is recollected, that in the reign of Charles I. bar-iron in Ireland was worth £18 sterling per ton. At Drumshambo and Drumsna, in Leitrim, "bloomeries" were formerly constructed, and iron smelted on an extensive scale. The Tyrone Basin, extending between Dungannon and Stewart's-town, contains (in thin beds) some thirty feet of coal, with ores of iron. It is affirmed that more beds of workable coal occur in this small field than any other in Ireland. Iron furnaces were formerly in operation at Castledawson, in the south of Derry, and about two miles from Loch Neagh; some beds of good clay iron-stone are found here; and coal and iron-stone have recently been discovered in partial quantities at Moneymore, not far from the above place. Valuable blackband iron-stone is found at Ballycastle, country of Antrim, some cargoes of which have recently arrived at Glasgow, and sold at nineteen shillings per ton, of twenty-two and a half cwts.

Although the coal-fields of Ireland, as far as their bituminous contents are as yet known, would appear to be incapable of permanently supporting any very extensive smelting establishments, yet some few of them obviously contain very ample stores of the mineral. Mr Griffiths, before a Committee of the House of Commons, in 1824, stated his opinion, that in the coal districts of Lough Allen, in Leitrim, there were still remaining 8000 English acres of good three feet coal, particularly exempt from water, which would yield upwards of 30,000,000 tons. He has also stated, in reporting on the Fowlerton Colliery, near Castlecomer, Kilkenny, "that although considerable workings have been made, and pits sunk, no coal, except that which lies near the surface, has been worked, and that the best and most solid part still remains untouched." This anthracite basin contains eight beds of coal. The extent of the supposed workable areas of coal in Ireland are as follows in acres:—Ulster, 500,000; Connaught, 200,000; Leinster, 150,000; Munster, 1,000,000.

It cannot at all events, we should imagine, but be pretty readily conceded that, in the aggregate, enormous supplies of unexplored mineral must be treasured up in these capacious repositories; and it can be no less apparent, that such realizations are highly essential to the successful development of any very extensive and elaborate projects for the smelting, and manufacturing, of the indigenous iron ores, especially when we remind our readers that it has been calculated, in the various processes from the smelting to the casting and rolling, the weight of coal used is about five times that of the iron; so that a produce of 1,600,000 tons of iron would absorb the enormous quantity of 8,000,000 tons of coal. As regards, however, the mere smelting of the ore, by Mr Neilson's discovery of the hot air process, one ton of iron can be procured with only two tons five cwts. of coal; whereas, in 1829, with cold air, the same quantity of iron consumed eight tons one cwt. of coal.

It has already been intimated that the coal of Connaught and Ulster is bituminous, whilst that of the south of Ireland is anthracite; and it will serve to illustrate the difference between the former, or a rich blazing coal, and the latter, or a stone coal, to state that an analysis, showed in one hundred parts of parrot coal fifty-six parts of volatile, or bituminous matter, to thirty-nine of charcoal; whereas in Kilkenny coal, was found only four of volatile matter to ninety-three of charcoal.

Considering the amazing importance which the iron trade has now assumed as a branch of national industry, and also, that a very general impression exists that Ireland is greatly deficient in the raw material, we have deemed it of consequence to direct especial attention to the resources above enumerated, and which, be it observed, are but the more prominent of the various iron-ore deposits of the island, as our exemplifications elsewhere testify. Where there is a deficiency of coal for smelting, as in the Cork and some other districts where iron-ore is abundant, the newly discovered processes in the preparation of peat, or applying it as charcoal to such purposes, will, perhaps, provide a most advantageous and inexhaustible substitute, and in all probability lead to the production of a material, that in quality may not only vie with, but surpass the best iron at present manufactured by the great iron-smelting establishments of England and Scotland.*

The manufacture of *good iron* is so obviously important, and especially in its bearing on the permanent prosperity of the trade, that the most effective means of accomplishing such a desideratum, cannot be too assiduously entertained by all engaged or interested therein. Dr Percy, whose experience and ability in metallurgical investigations are well known to the mining public, makes the following judicious remarks on this subject:—“There is no metallurgical problem of greater practical importance than the determination of the causes which occasion the differences in quality of the various kinds of iron, differences which have long been recognised by engineers familiar with the use of iron in the construction of bridges, buildings, and railways. Now it is certain that, exclusive of the effects due to mechanical treatment, these differences in quality are of a chemical nature. It must be borne in mind that chemically pure iron is known only as a curiosity even in a laboratory; and that all the substances to which the term iron is commonly applied are compounds, and frequently very complex compounds. The differences of chemical constitution in iron must depend upon differences of chemical constitution either in the ores, the fuel, or other materials used in smelting, or upon differences in the mode of conducting the process of smelting. It has been demonstrated that all these causes, either separately or conjointly, may be powerfully operative in determining the quality of iron; and it may be asserted that not the least influential are those which relate to the *ores* and *fuel*."

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* See Chap. XI. on Peat Bogs, &c.

Very recently, a favourable report was forwarded by the Woolwich Dockyard authorities to the admiralty, on the invention of the Abbé Pauvert, for producing steel of very superior quality from the most ordinary cast and puddled iron, and pieces of iron in any state, at an extraordinary reduction in price. M. Pauvert has secured his invention by a patent from the British Government. The articles of newly invented steel tested at the dockyard were clipped tools, chisels, taps, dies, and other instruments in general use in factories. The conversion of the metal does not require the slightest change in the arrangements of the melting furnace, it being simply effected by *chemical* ingredients and electric agency. The advantages of this invention, will be rendered sufficiently apparent, when it is stated, that steel of superior quality has only been fabricated hitherto from Swedish iron, which, according to current prices, costs between £14, 10s. and £16, 10s. per ton, whereas by the Abbé Pauvert's process the same is procured from British forged pig iron, varying in price from £4, 10s. to £5 per ton; or, as we have intimated, even from old refuse or scrap iron. The cost of the conversion of the metal will not exceed £1, 5s. to the ton, nor will there be any loss of material whatever, as one ton of the worst iron yields one ton of raw steel. This most important discovery has already been brought into operation by the Messrs de Beauchamp, M. Benoit d'Asy, and other large iron-masters in France.

The introduction of this staple and reliable source of British industry into Ireland, is a desideratum of the first moment, not only as a most powerful stimulus to its native enterprise, employment, and prosperity, but to the general interests of the kingdom. The annual make of iron in Britain now considerably exceeds 3,000,000 tons; and its declared value in exports, [illegible] with [illegible]

[illegible]

[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]

When it is considered that each furnace kept at work for making iron from the ore will employ 3000 persons annually, it will readily be conceived how immense is the absorption of labour by this branch of national industry only; and it very forcibly reminds us, what an amount of comfort and home happiness, would but even a moderate introduction of such establishments afford to thousands of the unemployed half-starved poor of the Sister Isle.

CHAPTER IV.

CARBONIFEROUS LIMESTONE OF CENTRAL IRELAND—CLAY-SLATE AND SANDSTONE OF THE ARRAN MOUNTAINS—COAL-FIELD OF KILLENAULE—MINERAL RICHES—PRODUCTIVE LEAD MINES OF CLARE—COPPER AND LEAD MINES OF TIPPERARY—IRON, COPPER, AND LEAD ORES OF LIMERICK—MANGANESE, BLACK AND VARIEGATED MARBLES—STATISTICS OF SOME OF THE CHIEF MINES IN SOUTHERN IRELAND—SOIL OF LIMERICK, TIPPERARY, &C.—FLUVATILE TRACTS OF THE SHANNON—ART OF IMPROVING SOIL—GOLDEN VALE—AGRICULTURE OF MUNSTER AND LEINSTER—GEOLOGICAL GROUPS OF ANCIENT ROCKS—SOIL OF CENTRAL PLAIN, &C.—BASALTIC ROCKS—PLANTING AND DRAINING—SILURIAN SCENERY—THE SHANNON.

DIRECTLY from beneath the millstone grit and associated coal measures, ranging north and south of the estuary of the Shannon, the carboniferous limestone emerges to the eastward, often in bold and serrated outline; the lower series mainly, of which, spread out from hence, more or less, over the several counties of Tipperary, Limerick, Clare, King's County, Queen's County, Westmeath, Roscommon, Longford, Mayo, Galway, &c.; in short, chiefly constituting the great undulating plain of central Ireland. It forms the western boundary of the coal formations of Kilkenny, and is here and there interspersed with extensive deposits of the lower Silurian clay-slate rocks, and of the Old-red-sandstone, especially in the south of Galway, eastern borders of Clare, and in Tipperary; throughout this tract these two great formations are singularly interposed with regard to their relative positions, and no less complex in their general outline.

The more mountainous parts of Clare consist chiefly of clay-slate and sandstone, flanked by the limestone. This range extends across the Shannon into Tipperary, where they constitute a small group called the Arran Mountains. The coal-field of Killenaule, occurring between the southern groups of mountains—Slievh-na-man and the Galtees, composed of sandstone—constitutes an area of about eighteen miles in length from N.E. to S.W., and about six miles in breadth. The surface of this coal tract is characterised by a series of low hills extending into Kilkenny; their strata being, in fact, conterminous with those of the anthracite district of that county. Trap rocks appear on the western side of Tipperary singularly interstratified with the limestone.

Nearly the whole of this vast area of limestone, with its occasional, dark and lofty, protrusive masses of clay-slate, &c., may be said to be composed of the most productive ore-bearing strata in the whole geological series; of the truth of which, as regards copper, the Berehaven, Allahies, and other mines, situated in the Glengariff and Magillicuddy slate ranges are notable examples, the extensive calcareous district under consideration has, however, been but very partially explored for mineral riches, though some astonishing deposits of lead ore have been discovered in the lower limestone east of Clare. One of this class was found in a bog near Ballyhickey, where a north-east and south-west lode was intersected by a tributary vein, in the angle of forty-five degrees; at this point the mass of ore was from fifteen to twenty feet wide, in places almost pure. This massive branch, or bunch, extended to a length of forty feet, and still orey at the depth of eleven fathoms. Near Quin, in the same county, is the rich argentiferous lead mine of Kilbricken, which produces ore yielding seventy-six per cent of lead, and 120 ounces of silver to the ton, and has realised about £1000 a year in royalty. Antimony has occasionally been met with in this district.

In the clay-slate in the gorge of Killaloe, and other places, lead and copper are wrought. Slates of a superior quality are extensively quarried in the neighbourhood of Killaloe, on the eastern side of Lough Derge; from the level expanse of which the Shannon precipitates its voluminous waters adown the rocky declivities of Doonas and Castle Troy towards the ancient city of Limerick.

It may not be irrelevant to mention here what is generally given as a test of the fitness of slates for roofing and other external purposes:—Lay one in an oven till perfectly dry; weigh it, and then immerse it in water for some time. When taken out, wipe it carefully with a dry cloth, and weigh it again. Those slates which have acquired the least additional weight, and consequently have absorbed least water from being the least porous, are the fittest for roofing. Good slates should be thin, dense, and of a smooth surface. Balance one on the finger, and strike it with a hammer; if the sound is clear, the slate may be considered as firm; if dull, the slate is less dense, and should be rejected.

In Tipperary alone, some ten copper and half a dozen silver-lead mines are now in operation. It was formerly found that the separation of silver from lead ore was profitless if the lead contained less than six ounces to the ton, but by a process discovered by Mr Hugh Lee Patterson, silver may be profitably separated from the lead when three ounces only are found in a ton of ore.

The Holyford and Lachamore mines, all consist of copper; Colleen, Garryard, and Ballygown, of lead; Shallee, of lead, silver, and copper; Knockanroe, of lead with zinc, sulphur ore, and copper; Gorteenadiha, of lead and copper; and Cloonanah, of sulphur ore; these mines are all situated in the county of Tipperary. The Castletown, Crumlin, Doolin, Glendree, Milltown, and Aughinish lead mines are in Clare.

In the vicinity of various trap protrusions, in the county of Limerick, iron, lead, and copper ores are found, and in the mountainous parts of the barony of

Burrin, and throughout the limestone tracts, cropping out along the western and south-eastern borders of the great coal-measure districts of Clare, Limerick, and Kerry, there are some rich lead ores and abundance of copper pyrites; and on the coast from Kilrush to Carrigaholt, some good slate and slab quarries are in operation; in some places manganese is obtained, and veins of coal and ironstone are occasionally seen, appearing to the day, at Lemaduff, &c. The upper limestone, in the neighbourhood of Ennis, produces a very fine black marble, which takes a high polish; it is also found at various other places along the outcrops of these beds. Some fine variegated marbles occur in the county of Cork, also at Clonmacnoise and Church Town; but the most highly esteemed marbles are procured from the quarries of Connemara; and also Kilkenny and Carlow, where the limestone rises from beneath the millstone grit.

The following statistical facts respecting a few of the principal mines, situated in some of the districts we have been cursorily examining, will forcibly exhibit the actual character and value of this important division of their material resources. In 1853, the Cork copper mines yielded 5863 tons, Waterford furnished 3371 tons, Tipperary 550 tons, and Wicklow 1487 tons of copper ore. In the month of July 1854, the excellent Dublin correspondent of the Mining Journal, reports:—Knockmahon, Berehaven, and Ballymurtagh mines, continue their steady course, making returns instead of reports, and declaring dividends instead of calls; the sales this past week were, of the former, 151 tons, producing £2623, 11s. 6d., or an average of £17, 7s. 3d., per ton, the produce being 16; while the ores sold from Berehaven were 126 tons, with a produce of 10⅛, produced £10, 11s. per ton, or £1329, 6s.; and next week there is announced for sale—Berehaven 325 tons, which we may assume as £3250; Knockmahon 144 tons, say £2500; Ballymurtagh 94 tons, say £500; Lackamore 56 tons, or £560; Holyford 50 tons, say £1000; and Cooshen 45 tons, which would bring £675; in all, 714 tons, which may at least be calculated on yielding £8485; making gross sales for the fortnight of 991 tons, yielding £12400 from these several mines. Such returns are well calculated to inspire confidence; the annual produce of four mines alone, in all 10,960 tons, producing £115,648, or an average of £10, 11s. per ton; respectively standing as follows:—

	Tons.	Average Price.			Amount.		
Berehaven	5332	£10	5	0	£54,634	13	6
Knockmahon	3890	11	9	6	44,593	9	0
Holyford	502	21	6	6	10,700	7	0
Ballymurtagh	1236	4	12	6	5,719	15	6
Together	10,960				£115,648	5	0

Or, as near as possible, the money value of the ores sold from these four mines is equal to one-tenth of all the ores raised in Cornwall and Devon; which, it appears, was £1,153,756, 3s. 6d., the average produce of which being six and a half tons, and yielding an average price of £6, 7s. 6d. per ton.

At the Swansea Ticketing, on June 2, 1857, copper ore, to the amount of 840 tons, the produce of Irish mines, was sold, realizing £10,475:—

	Tons.			
Knockmahon Mines	458	£5906	3	6
Berehaven	296	3151	16	0
Holyford	53	1016	15	0
Cronebane	30	200	9	6
Tigrony	13	99	16	6

The great outlet for the metalliferous and other natural products of the south of Ireland, is the noble harbour of Cork, and to which, the "Beautiful City" owes all its prosperity. In natural beauty and spaciousness it is unequalled by any in the kingdom, and is said to be large enough to contain the whole navy of Great Britain. It is a great victualling station, and the Cork establishments for the preparation of naval provisions are nearly as extensive as those at Portsmouth or Greenwich. Queenstown, as may be seen by the frontispiece to this work, is delightfully situated on an eminence, which rises precipitously from the margin of this fine lake-like expanse of sea; magnificent views of which, with its several islands and diversified shores, are afforded, in increasing interest, as the spectator continues to ascend the terraces to the more elevated parts of the town. A sail from Cork to Queenstown has frequently been described as one of the rarest and most interesting in Ireland; a rich and diversified foliage clothes most of the hills, from the water's-edge to their summits, and amongst which a profusion of handsome villas and ornamented cottages, with here and there a picturesque ruin, are charmingly interspersed. "The whole distance," says Mrs Hall, "to the landing-quay from the harbour's mouth, about twelve miles, is one continued scene of varied interest. To do full justice to the exceeding beauty of the River Lee is impossible. On either side, after passing the harbour's mouth, numberless attractive objects in succession greet the eye, and the wild and the cultivated are so happily mingled, that it would seem as if the hand of taste had been everywhere employed skilfully to correct and improve nature."

The soil of Limerick, Tipperary, Kilkenny, Queen's County, and eastern division of Clare, is extremely varied, resulting from the rapid succession of distinctive geological formations occupying this central region, and the great elevation which some of them attain. The interior of Clare county west of the lofty Slievebaughta mountains, &c., forms, however a marked exception, being mainly composed of the poor tenaceous marls and grits of the lower coal measure series, and presenting a comparatively level appearance both north and south. The vast undulating plains of Limerick, sloping towards the Shannon on the north, present a very similar topographical character, and are bordered on the south and west by hills and conspicuous mountain groups.

Wherever a proximity occurs of the several formations of the old-red-sandstone, clay-slate, and limestone, the neighbouring slopes and vales, occupied as they usually are, by deep deposits of debris, resulting from the decomposition of these rocks, are frequently extremely fertile. The vast fluvatile tracts bordering the Shannon have for the most part derived their well-mixed materials from such sources; being thus abundantly supplied with those mineral and chemical constituents which contribute so essentially to the luxuriant development of vegetable life, namely—lime, silex, alumina, potash, soda, magnesia, oxide of iron, sulphuric acid, phosphoric acid, &c.

The great art, indeed, of improving soil is to add to it the mineral ingredient, or those necessary forms of vegetable food, in which it is deficient; for, upon the chemical nature of the medium, or the influence of artificial changes in the soil, the plant is singularly dependent. Thus, "when a peaty soil is drained, the heaths disappear, and a soft wooly grass (*Holcus lanulus*) overspreads its surface. A wet clay is laid dry, and the rushes and water-loving plants are succeeded by sweet and nutritious herbage. Lime is applied, and sorrel and sour grasses are banished from the old pastures; and corn then ripens and fills the ear where formerly it languished and yielded scanty returns of unhealthy grain. Crushed bones are strewed over a meadow, and abundant milk and cheese show how the eatage of cattle can be improved —or they are drilled into the ploughed land, and luxuriant root crops exhibit their ameliorating effect —or guano, or nitrate of soda, or the liquid of the farm yard, or the droppings of cattle, are spread upon the scanty pasture; and straightway the humble daisy and the worthless moss—symbols of poverty—disappear, and rejoicing crops of most fragrant hay prove the close connection of the plant with the soil on which it grows."

The provinces of Munster and Leinster, contain many fertile valleys of the kind we have adverted to, and in some of which a rich calcareous loam predominates. But the most celebrated is the Golden Vale, "a tract of remarkable fertility stretching westward out of the county of Tipperary, from the sources of the Maigue to the Mulkern, and said to include an area of 160,000 statute acres, occupying the greater part of the western plain of the county. This valuable tract is equally suited to grazing and tillage, but is chiefly pasture, and one acre is considered sufficient to fatten the largest bullock and a sheep. But a still richer soil is that of the tract called the Korkasses, extending fifteen miles along the southern bank of the Shannon, from below Limerick to the debouch of the Deel. In this quarter the greatest wheat crops grown in Ireland are produced, and the potato crops are often remarkably prolific." At Mountmellick, six miles from Portarlington station, are situated the works of the Irish Beet-root Sugar Company. The rich loamy soils, and physical conditions generally, characterizing the locality in which the beet is cultivated, have hitherto produced such promising results, that it is confidently believed the manufacture will become a very important branch of the industrial resources of the country.

The surface of Tipperary is extremely diversified, and presents a very large area of greatly elevated and barren tracts of land. The Galtimore mountains consisting of a central nucleus of the lower Silurian clay-slate, and surrounded by a broad belt of the Old-red-sandstone, form a conspicuous and beautiful group a few miles to the south of the above city. Arthur Young designates them the finest of the Irish inland ranges, both as regards their elevation, their appearance, and the generally fertile nature of their surface. Galtimore, the highest summit, attains an elevation of 3008 feet above sea level. In passing from hence across the rich undulating limestone district *surrounding* Tipperary, to the north of the county, we arrive at the first of the three mountainous groups, all of similarly constitued geological features, and extending into the eastern division of Clare, where they are known as the Inchiquin mountains, the southern or Slieve Phelim mountains being the most extensive. The latter presents a large triangular area of the lower Silurian rocks, flanked on all sides by the lower and upper Devonian arenaceous formations, and which trend off in bold ranges to the north-east, extending between King's County and Queen's County, where they terminate in the broad and towering groups called the Slievebloom mountains. The older Silurian clay-slate, in smaller areas, also forms the nucleus of the Clare group, and the central range which rises on the southern shores of the far-famed, but dreary, Lough Derge, and they are alike similarly skirted by the Old-red-sandstone deposits. The three groups, however, which are more especially distinctive in a geological sense,—run so nearly into each other, that they may very well be considered as one continuous mountain range, whose promontories, on every side, advance boldly out into the central undulating limestone plain of Ireland.

Fertility, and a varied adaptation for the reception of almost every crop, are the very general characteristics of this extensive calcareous plain; in the vicinity of the groups just particularized, the productive nature of the soil is often very conspicuous; the arenaceous detritus of the Devonian rocks, performs a most beneficial part, where it happens to be disseminated amongst the stiff alluvial, or post-tertiary clays, which here and there deeply cover the surface of the prevailing limestone formations. This sort of derivative fertility is very apparent in the eastern plains of Limerick, where there are numerous occurrences of Basaltic rocks, the mechanical and chemical decomposition of which, have exerted additional and most beneficial influence in the agricultural value of the soil. The productive qualities, however, of even the best of such happily constituted mediums, are not unfrequently, more or less neutralized, in the absence of a duly attempered warmth and moisture. And here, as in many other parts of Ireland, it is abundantly manifest, that there are most extensive tracts of land, the high, natural, prolific powers of which cannot be questioned, but which are rendered almost nugatory, or, as in many instances, entirely worthless, solely for the want of a little judicious *planting* and *draining*. Millions of Irish acres are, indeed, only awaiting the magic hand of culture, which, generally speaking, if even but sparingly and inexpensively applied, would soon gratefully teem with a luxuriance of herbage, or with cerial burdens, equal to, and even surpassing the produce of the finest and best cultivated soils of Britain. M'Culloch, amongst several other writers, who have *borne testimony* to these inherent capabilities of the lands of Ireland, remarks, that "the luxuriance of the pastures, and the heavy crops of oats that are every where raised, even with the most wretched cultivation, attest its extraordinary fertility."

But throughout the whole extended area of the neighbouring mountain heights, the surface rock imparts a distinctive character to the soil, changing as it changes. However, (as in the porous chalk tracts, or the impervious crystalline ranges,) the commercial value of a soil is often naturally affected by physico-geological considerations, which are altogether independent of the chemical composition of the rock from which it is formed. The mere physical character of the sub-formation from which the soil is derived, frequently determines not only the kind of husbandry, but class of farmers by whom the land is to be occupied, and where it can be profitably cultivated at all. Circumstances, which the practised eye of a good agriculturo-geologist, would, on entering any new district, be enabled to detect almost at a glance, for, as the great geological formations, for the most part, possess a peculiar and distinctive physiognomy, he can thus, by their mere outline, or external features, usually determine their true geological character.

The scenery presented by the silurian ranges we have been adverting to, is remarkable for its towering and deeply serrated aspect, often contrasting strikingly with the sweeping rounded eminences, so characteristic of the Old-red-sandstone by which they are environed. They constitute much of the romantic scenery in the neighbourhood of the extensive Lough Derg, and though deficient in wood, contribute largely to the picturesque glories of the magestic Shannon. This fine river is said to have been thus addressed by Lord Macartney, when embarking in 1791 for his government at Madras:—

————" Raptured I try the strain,
Great King of floods! to hail thy new-born reign,
Which breaks from darkness like the rise of day,
And gives the promise of imperial sway!
Already commerce spreads her ample stores,
Pours Afric's riches on Ternia's shores;
Brings either India's treasures to her view,
Brazillian gold, and silver of Peru!
Bids wondering navies on thy billows ride,
Roll the world's wealth, O Shannon, to thy tide."

CHAPTER V.

GEOLOGICAL FEATURES OF CONNEMARA AND WESTERN IRELAND—METALLIFEROUS INDICATIONS—LEAD AND COPPER MINES—NAMES AND LOCALITIES OF VARIOUS MINES—CUMBRIAN CLAY-SLATE TRACTS—THEIR METALLIC ORES—GALWAY MARBLES—IRON ORE, VALLEY OF THE DEEL, &C.—SULPHUR ORES OF CLARE ISLAND—COPPER AND LEAD MINES OF SLIGO—GEOGNOSTIC CONDITIONS, VICINITY OF LOUGH CONN—PHYSICAL FEATURES OF CONNEMARA—IMPROVEMENT OF ITS SOIL—GALWAY GRANITIC TRACT—LIMESTONE OF LOUGHS MASK AND CORRIB—AGRICULTURAL IMPROVEMENTS OF A NEW RESIDENT PROPRIETOR—PHYSICAL CHARACTERISTICS OF WESTERN CONNAUGHT—ITS PASTURAGE AND CROPS—ROSCOMMON AND MAYO—SOIL OF SLIGO AND LEITRIM—MEDICINAL SPRING—SOURCES OF THE SHANNON—ITS EXTENT OF NAVIGATION.

AN extensive maritime district next claims our attention, extending through Galway, Mayo, Sligo, and Leitrim, to Lough Earn, opposite Donegal Bay; and which is no less remarkable for the boldness, sublimity, and charming variety of its physical conformation, than for the extremely complicated and interesting character of its geological details. Its general geognostic structure is comprised of granite, mica-slate, lower Silurian slate, upper, middle and lower carboniferous limestone, greenstone, porphyry, metamorphic primary limestone, upper and lower Old-red-sandstone, massive quartz, and the coal formation, which is chiefly in Leitrim. These formations, for the most part, succeed each other in rapid succession, and together often present a physiognomy at once fitful, rugged, and wild.

The granite constitutes the whole of the northern coast of the fine Bay of Galway; it is irregularly elliptical, stretching out about thirty-six miles in length by twelve broad. The mica-slate reposes immediately on its northern skirts, and continuing northward forms, in tortuous outline, the whole of the extreme western coast, extending north and south of Clew Bay, with the exception of narrow strips of the Old-red-sandstone and limestone on its borders; and a rather wide zone of lower clay-slate, mainly forming Killery Inlet, here constituting, the finest mountain scenery in Ireland. In the mica-slate district, to the south of it, appear the abrupt and whimsical forms of the Twelve Pins, varying in height from 1800 to 2400 feet, and which are singularly intersected with quartzose, serpentine, and metamorphic limestone, rocks, and from whence are derived some of the finest of the beautiful and unique green marbles of Galway. Quarries of black and variegated marbles also abound. This extraordinary and beautiful group of mountains occupies a space of nearly five miles square, in the centre of the Connemara and Joyce region.

From Lough Corrib, in the vicinity of this range, the lower limestone extends northward through Mayo to Sligo Bay, with occasional protrusions of granite, greenstone, and mica-slate; this calcareous tract being bordered to the north of Clew Bay by a considerable deposit of Old-red-sandstone. The Ox mountains, an extensive range traversing Mayo and Sligo, consist chiefly of mica-slate, with occasional protrusions of granite, gneiss, hornblende slate, and quartz rock. Both sides of the Ox mountains are skirted by the Old-red-sandstone and conglomerate, and which disappear beneath the carboniferous limestone, constituting the lower tracts, which extend between the sea and the Curlew mountains on the borders of Roscommon; belonging to the Old-red-sandstone group; the Braughlieve mountains being connected with the carboniferous system. Lead and copper mines were formerly wrought in the primary region to which the Ox mountains belong, and where numerous promising lodes are to be met with. On the shore of Killala Bay, trachyte is found,—a mineral not observed elsewhere in the British Isles. The greater part of Leitrim, as before intimated, is occupied by its valuable coal-field, occupying an area, altogether, of about 140,000 acres; whilst from its northern borders to Donegal Bay, the middle or calp limestone predominates.

Metalliferous indications are abundant in Connemara and neighbouring districts. The lead mines, chiefly of galena ore, at present in working are principally in limestone, though the lodes occasionally pass completely into the granite and slates, quartz or sandstone, the ore being found most abundant at or near the junction of two formations. In the transition and trap districts of Galway some ten copper and nine lead mines are at the present time in progress, two mines of sulphur ore, and one of iron. Mayo, Sligo, and Leitrim, have as yet been but very partially explored for metallic veins; in the two former counties, there are eight or ten mines, consisting of copper, argentiferous lead, and sulphur ore; and in Leitrim a few of iron, copper, and lead.

In the neighbourhood of Oughterard, in the romantic district bordering Lough Corrib, and where the granite, mica-slate, and limestone form a junction, some promising lead and copper lodes and sulphur ores occur; as also, in the highly picturesque region of the Twelve Pins, or Binabola Mountains, which, comprised of two distinct ranges, are connected with the elevated pass of Maam Ina, and enclose a multitude of lakes.

In the Clifden district, Galway, copper lodes are wrought at Cloon, Fakeeragh, High Island, Boolard, and Ardbear; copper and lead at Leenaun, and iron at Rynvyle. Lead mines are in progress at Inveran, Kilroe, and Derrynea, near Galway. The Claremount mines consist of copper and lead, and there is one of lead at Rinville, and in Kinvarra one of argentiferous lead. A mine of copper and sulphur ore is in operation at Carraghduff, one of copper at Deersura, and one of silver and lead at Lemonfield. Ironstone and manganese occur in abundance in the Island of North Arran, off the coast of Donegal.

In the lower, or Cumbrian, clay-slate tracts which skirt the Binabola ranges to the north, and together with the Old-red-sandstone, form the western shores of Lough Mask, indications of lead and other minerals are of frequent occurrence. Yellow ochre and potter's clay are also met with. Manganese exists in the Slieveanorr, or Gold Mountain, and beautiful variegated black marble is quarried from the upper limestone, near Galway. The greater part, or north-western division of the county Mayo, being occupied by mica-slate, and the upper and lower Devonian formations, it is not very rife in the precious metals. A rather singular series of trap dykes, or rather channels of trap rock, traverse this part of the country, (extending into Sligo), in an east and west direction; their average breadth seldom exceeds forty feet, and they have a lineal extent of about sixty miles; being unexampled for length, directness, and parallelism. When metalliferous lodes run parallel to, and in close proximity with, these ribs of whinstone, they frequently prove very productive. In an instance of this kind, which occurred in the mines of Islay, a rib of solid ore was wrought for some time from two to three feet in thickness, and deeper down on the other side of the same channel of trap rock, and quite close to it, a rather wide vein of soft killas was found impregnated with lead ore. Numerous instances, indeed, might be cited, where ore has been thus discovered on one, and occasionally on both sides of a whin dyke, the courses of ore being sometimes of a very rich and fruitful character.

In the western and south-western districts iron-ore exists in considerable abundance; at Tullaghawn Bay, and in the valley of the Deel, bloomeries were in operation, but are now suspended for want of fuel. And a copper mine is worked in Achill Island, off the south-western shore, and one of sulphur ore in Clare Island. In the lower limestone tracts (occasionally to be seen resting on sandstone and mica-slate) bordering Westport Bay, mines of copper, sulphur ore, and argentiferous lead, are in operation. The environs of this place are of a peculiarly romantic and picturesque character; the road by the Sheffry lead mines and over the pass of Barnadarig is fraught with interesting scenery of this description; and thousands of acres of the neighbouring mountain slopes are admirably suited for the depasturage of sheep.

An association, termed the West of Ireland Mining Company—capital £50,000—is now in course of formation, under very favourable auspices, for the purpose of exploring and working the minerals on the extensive estate of the Marquis of Sligo, occupying an area of some 200 square miles, and mainly situated in the mountainous region extending between Lough Mask and that part of the sea coast, which, in sinuous outline, stretches out between the Killeries and Achil Sound, on the north coast of Clew Bay. This capacious area affords a very promising field for mineral explorations, being occupied by a variety of formations, which, for the most part, are of a metalliferous character,—as, for instance, silurian slate ranges, carboniferous limestone, quartzose rocks, with occasional isolated primary and trap protrusions, and trap dykes—the masses of trap being of pretty frequent occurrence in the mica-slate district south of Clew Bay, and the basaltic channels in the wild, and often deeply scarped, silurian slate tracts ranging north of Killery inlet.

It appears that the attention of the company will first be directed to re-opening the long deserted works of the well-known Sheffry lead mine, and which contains a large per centage of silver. The mine was formerly wrought by means of a series of adit levels, driven from the slope of the hill, on the back of the lode, which maintains a pretty well defined course, in a nearly north and south direction, for several miles in extent, and slightly inclines to the north. It is also intended to work the fine black marble quarries near Westport, and the green marbles, flag, and slate quarries, situated on other parts of the property, and on which highly promising indications of copper, rich beds of bog iron-ore, fuller's earth, ochre, and potter's clay, are known to exist. It is hardly necessary to advert to the vast local advantages, or the incalculable benefits, which, in a variety of ways, cannot fail to emanate from operations of this effective character, having for their object the development of the mineral resources of a region so peculiarly inviting, in a geognostic and metalliferous sense, as this singularly romantic and interesting portion of the West of Ireland.

In the adjacent county of Sligo, silver-ore is found at Abbetown, and lead at Lugawarry; the Tormore mines consist of copper and lead. Whenever this county is more assiduously explored, it is highly probable that valuable deposits of lead ore, &c., will be discovered in the extensive lower limestone tracts, constituting the coast line between Sligo and Killala Bay, and trending from thence, into the vicinity of Lough Conn, where a considerable area of syenite, mica-slate, and gneiss, emerges from beneath the calcareous strata, thus affording geognostic conditions of still greater promise for the existence of productive mineral lodes. Any extensive development of these resources would greatly ameliorate the condition of the peasantry, who, in this part of the country, as well as in some of the neighbouring wilds of Connemara, are utterly unable to procure regular employment, and consequently, are often in a deplorable state of demoralization and wretchedness.

In taking a general view of the physical features, so peculiarly characterizing Connemara, one is forcibly reminded that here, indeed, the earth's foundations are literally "out of course." The glittering piles of granite, mica-slate, gneiss, quartz, serpentine, &c., often appear hurled together, as it were, in wild and magnificent confusion, alike defying the powers of description, and the arts of the cultivator, bold enough to attempt to render them tributary to the purposes of civilized life—a region, which, in fact, cannot perhaps be more graphically depicted in a few words, than by the writer who humourously says:—"It lieth under a dark cloud, which is evermore discharging itself on the earth, but like the widow's cruse is never exhausted, has a soil consisting of equal quantities of earth and stones, and abounds in lakes, bogs, and other natural curiosities." These mountainous solitudes are held by a hardy race of farmers, living in a very primitive state; in their wild pastoral valleys and far-stretching mossy plains, they have numerous herds of cattle and horses, for which the district has long been celebrated. Tillage is almost entirely neglected, and little or nothing done by them to redeem the dreary features of their native wilds.

The penetrating eye of science, however, detects, even here, the elements of fertility and improvement, and the spirit of enterprise has already invaded these rude domains, and filched from them many a reclaimable waste, which now contrasts as gloriously with the sombre rugged scenes around, as does the smiling oasis with the sandy desert. Mr Nimmo, in his able report, bears strong testimony to the capabilities of this rocky wilderness, where he says :—" Though the general improvement in the cultivation of Connemara would seem an undertaking of the most arduous description, it is not without facilities which might, upon a candid consideration, make it appear a subject more worthy of attention than many others of the waste lands of the kingdom. On the whole, it appears to me, that the improvement of this district, so far from being difficult and hopeless, is a thing highly feasible, and if vigorously, but steadily pursued, is likely to meet with fewer obstructions and greater ultimate success than perhaps any other part of Ireland." He further observes, in reference to the natural capabilities of Connemara and Joyce County, that " Various great inlets penetrate the district, so that no part of it is distant four miles from existing navigation. There are upwards of twenty safe and capacious harbours, fit for vessels of any burthen ; about twenty-five navigable lakes in the interior, of a mile or more in length, besides hundreds smaller ; the sea coast and all these lakes abound with fish.

The district with its islands possesses no less than four hundred miles of sea shore. On Lough Corrib it has about fifty miles of shore; so that with Lough Mask, &c., there are, perhaps, as many miles of shore of the sea, or navigable lakes, as there are square miles of surface."

The number and variety of the geological formations occupying these western districts of Connaught, have largely contributed to the deep deposits, of fertilizing ingredients, which constitute fine loamy soils of very considerable extent, in the valleys and at the foot of mountain ranges. And although the extensive area of granite skirting the northern shores of Galway Bay, is for the most part too elevated to be cultivated to much advantage, its predominating constituent is (a flesh-coloured) Felspar—a mineral of paramount importance in an agricultural point of view, as crumbling down rapidly beneath the atmospheric influences, imparting, by its alumina, consistency or body to the soil, and by the large quantity of potash it contains, furnishing the salinous ingredients most conducive to the exuberant growth of vegetation. Limestone of an excellent quality abounds along the eastern shores of Lough Mask, Lough Corrib, &c., and can be thus readily obtained at a very moderate expense, to be most advantageously applied, on the extensive clay-slate and mica-slate tracts, stretching out from their western borders to the sea, as also in the reclamation of the vast bogs which so thickly stud the adjacent districts, caustic lime being the best manure for peat soil.

To persons, however, who take but a cursory view of such wildernesses, the idea of any very remunerative results from the cultivation of their far stretching wastes, must appear so chimerical, that we cannot resist here subjoining an extract from a letter of high authority, lately addressed to the *Times*, and which, it will be seen, amply testifies what really can be done with neglected or unimproved lands in Ireland, by the judicious application of a little skill and capital. The writer, who purchased the fee-simple of 2000 acres on the banks of the Shannon for £3000, says:—"Driven from the army, in which I was Lieutenant-Colonel, by illness, and seeking health by travelling in Ireland, I was struck by the advantages of purchasing under the Encumbered Estates Bill. I found a property beautifully situated, but in a wretched state of farming, with a number of small tenants. I bought it at ten years' purchase. My first step was to get rid of the tenants off that portion of the land which I determined to commence improving and farming. There was half-a year's rent due directly after the purchase; this I forgave them, paid their rates and charges, and bought their crops by valuation. From such as wished to go to America, I took their stock also by valuation; and for those who preferred taking other farms, I allowed their cattle to remain on my land until they found one. By these means I got all the land I wanted without any trouble, generally receiving the blessings of those who are represented, in England, as ready to murder under similar circumstances. Some of the smaller tenants still occupy their houses, work for me as labourers, and are well contented; I pay them eightpence a day, but most of my work is put out by the piece. I average seventy-five men and fifty women daily; the former are employed in draining, making roads, knocking down fences, and other general improvements; the latter in weeding, carrying turf, and picking stones. They are under the management of a Scotch steward, and are very amenable, but require much looking after, as they are inclined to be lazy. I purchased the land last autumn. I put in my spring corn, principally with the spade, and my crops are now looking well. The lands of this country are most fertile, forty to fifty tons of green crops per Irish acre are to be obtained by decent farming; stones for drainage, brick earth, water power for machinery, and turf, are on the land, and my produce can compete (by water carriage) in the London market with those 100 miles off by rail. The rates and charges set on land, if but a few English would but come over with capital to employ the poor and improve the land, would dwindle into nothing. I am living in a cottage without a lock or bolt, sleeping on the ground floor without shutters; I would not venture to live in England so little secure. I have received the greatest kindness from all ranks. We have nine or ten neighbours within visiting distance. I have grouse, woodcock, snipe, and hares upon my property; yachting close by: geese and cod fish are brought to me at one shilling each, large turbot two shillings, soles one penny each, fowls one shilling a couple, and every thing else in proportion. Now, Englishmen who have capital, with intelligent, active sons, think of land at ten years' purchase, improvable to an enormous extent, doing good in your generation, and able to laugh at free trade! I do not advocate the purchase of land without the intention of residence and improvement, but I am so confident of the advantages to be derived, that I am intending to stake all I am worth in the venture."

The chief physical characteristics of eastern Connaught, certainly afford desiderata of the first importance to the cultivator of the soil, and especially as regards the reclamation of its extensive boggy wastes:—firstly, a substratum of limestone, with a few inconsiderable exceptions, exists throughout; secondly, a mountain barrier protects its expansive plains and vales from the prevailing winds of the Atlantic; and thirdly, the sufficiently elevated and undulating disposition of its surface, offers the greatest facility to thorough drainage. Labour is cheap and abundant, the average of wages is stated to be only *sevenpence* per diem, and the average employment of labourers is only 125 days in the year. Very extensive tracts of good pasturage occur in the best parts of Galway, and grain crops are extensively raised, especially wheat, which is of a fine quality. A tract extending from Gort through Loughrea to Portumna, Eyre Court, and Ballinasloe, is said to possess the richest soil in the county. Barley and oats are extensively grown in the remainder of its eastern division. On the lighter soils great numbers of sheep are fed. The mountainous region to the westward abounds in vast uncultivated tracts. In some districts considerable breadths of bog land have been reclaimed.

Several properties have already been purchased under the Encumbered Estates Court, in this part of Ireland, and from the spirited system of improvement, which has been very generally adopted by the new proprietors, a very improved aspect is beginning to be communicated to the several localities. We are assured that some of these estates, requiring improvement, were purchased under seven pounds per acre fee simple; and by a moderate outlay on which, there is every probability of their being doubled in value in the course of a few years. Many very valuable and extensive properties in Connaught are now waiting to be sold under the Encumbered Estates Commission.

The upper and middle series of carboniferous limestone, extend from Clare, round the head of Galway Bay, a considerable distance into the lower calcareous districts just adverted to, constituting around Tuam a flat open country. But here, as in the west of Mayo, and in Roscommon, there are extensive tracts of upland pasture well adapted for the breeding of cattle, as also very considerable breadths of tillage, chiefly appropriated to the growth of oats. Much of the calcareous subsoils produce the most luxuriant herbage, and many of the valleys are remarkable for their deep rich loam. Rents vary from twenty-five to thirty-five shillings, and upwards, per acre. The valuable and extensive coal field of Leitrim to the north, affords but a cold, retentive soil; it is, however, entirely surrounded by a broad belt of the upper and middle limestone formations, which contain a variety of fertile and picturesque valleys. In these, and the calcareous tracts bordering Sligo Bay, lead ore is not unfrequently met with. A light sandy loam prevails about Sligo, with large patches of bog, but in the valleys and plains a rich and deep soil occurs, on a substratum of limestone, where all kinds of agricultural produce are successfully cultivated.

Timber, it is said, was formerly abundant in Sligo, but the consumption of it in the iron works, and the improvident use of it for domestic and other purposes, rapidly prostrated the woods, without the slightest regard to the formation of a fresh supply; but this defect is annually diminishing, and there are numerous plantations of forest trees round the mansions of the proprietors, and on the borders of the lakes. The tillage farms are from five acres, and even less, to 200 and 300 acres in size; those for pasture are most extensive, and the average rent of land is ten shillings and eightpence per acre.

Near the neat and rural village of Drumsna, County Leitrim, there is a strong sulphureous spring of great efficacy in cutaneous disorders. In the limestone hills, bordering the Leitrim coal-field, and about four miles to the north of Lough Allen, the Shannon takes its rise, and runs through ten counties, a distance of, at least, 234 miles, ere it debouches into the Atlantic. "Taking," says Mr Williams, "the double length of coast which the ten counties present to the navigation, at 500 miles, and which, considering the extent of the bays, inlets, and rivers, is under the fact, it leaves an average of fifty miles of coast to each county. This fact alone is sufficiently indicative of what may be done, commercially and otherwise, through the instrumentality of this one river."

The Slieve-an-ierin and Dowbally mountains form the eastern borders of Lough Allen, which is six and a half miles in length, and from two to three in breadth, lying 160 feet above the level of the sea; the western side of the lake is traversed by Slieve, Corkagh, Brahlieve, and Munster Kenny ranges, being part of the chain extending to Sligo Bay, and which, near the lake, attain an elevation of 1400 feet. The distance from Lough Allen to Leitrim is twenty-four miles by the Shannon.

The upper series of the carboniferous limestone of Ireland abounds in caverns; a cavity of extraordinary depth, from whence issues a spring said to be one of the sources of the Shannon, exists near the base of the Culcagh mountain, about six miles from Lough Allen. Rivers and streams frequently maintain their subterranean courses through these natural crevices for miles ere they emerge again to the surface. Some of the limestone caverns present stalactitic and stalagmitic displays of great beauty and variety.

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CHAPTER VI.

Mica-Slate of Donegal, Derry, &c.—Granite Tract of Donegal—Lead, Copper, and other Mines—Mineralogical Characteristics of Mica-Slate—Localities, &c., of various Mines—Porcelain Clay—Pure White Marble—Coal Basin of Tyrone—Lough Neagh—Chalk and Mica-Slate—Singular Geological Hiatus—Immense Quartz Veins, &c.—Character of the Soil in the Mica-Slate Districts—Agriculture, &c., of Ulster—Upper and Lower Loughs Erne—Geology and Scenery of do.—State of Rural Matters in Fermanagh, &c.—Privations of the Poor in Western Donegal—Policy of Encouraging Mining Enterprise.

Proceeding northward through Fermanagh and Tyrone into Donegal, we enter a district of great geologic and mineralogical interest. The mica-slate is largely developed in this remote corner of Ireland; it trends in a north-east and south-western direction, occupying the greater part of Donegal, Londonderry, and Tyrone; it flanks the granite range of Donegal, and spreading southward to the neighbourhood of Omagh, there dips beneath the tract of old red and yellow sandstone, which occupies nearly the whole of the south of Tyrone to the borders of Loch Erne. To the north the mica-slate skirting Loch Foyle constitutes the promontory terminating in Inishowen Head. To the westward of this point enormous ranges of quartz split up and traverse this formation, till the confines of the granite are reached, where hornblendic, gneiss, and greenstone rocks are interlaced in strange confusion. The wild and elevated granitic range of Donegal runs thence to the sea; being about eighteen miles broad and thirty-two miles in length. The granite is a coarse granular syenite.

Considerable tracts of the large district just adverted to are rich in metallic ores. This is especially the case where the junction of the mica-slate and granite occurs; they are here traversed by numerous metalliferous lodes; and gold, copper, and tin occur. In various parts of the country some twelve or fourteen lead and copper mines of excellent produce, or promise, are in operation. In the vicinity of Ballyshannon the lower mountain limestone is productive in lead ore and zinc; and sulphur ores also exist.

As above intimated, the metalliferous lodes occur in the lower beds of the mica-slate resting on the primary rocks, and although occasional veins, or rather beds, of metallic minerals are found in the mica-slate ranges, it does not here, of itself, afford any very productive or reliable deposits of such riches, and as, with isolated exceptions, is very characteristic of its extensive area in the north of Scotland. It, however, not unfrequently descends, by the admixture of felspar, into gneiss, one of the most metalliferous of the primary rocks. It is also often interstratified, in the upper series, with crystalline or primary limestone, and hornblende schists, together with greenstone or slatiform greenstone, and hence the vast field occupied by the mica-schist formation occasionally affords considerable inducements to the persevering efforts of the mineral explorer.

The mountains of Donegal, like the western islands of Scotland, offer a most instructive field to the geologist, for the study of mica-schist, with its associated gneiss, quartz rocks, primary limestone, clay-slate, and chloritic schist, more or less, with all of which it is frequently interstratified.

Some few irregular masses and skerries of plumbago have been discovered in the primary rocks near Ardava, County Donegal. Copper pyrites are found at Horn-head; iron pyrites at Barnesmore; and lead ore, ochre, and iron at Keeldrum; promising indications of lead ore are to be seen at Glentoger, Fintown, and neighbouring localities. Argentiferous lead with zinc and sulphur ores, occur at Carrowmore, copper at Clonca, lead ore at Drummacross, Ards, Givebarra River, Loughnambraddan, Mullantiboyle, and Castle-grove. Mafagh mines consist of lead, copper, sulphur ore, and iron; lead and copper are wrought at Inishkeel; and there are lodes of lead with zinc and sulphur ores in the Scraigs mountain. Trappean rocks exist in the vicinity of nearly the whole of the above mines and metalliferous deposits.

Porcelain clay is found in Arranmore Island, and pipe-clay near Stranorlar. A singular kind of steatite occurs near Convoy, on the Deele; it cuts with the knife like wood, and is much used by the country people for the bowls of tobacco-pipes. A very beautiful white marble occurs in beds of considerable thickness and extent near the Rosses, a tract of extreme wildness, chiefly belonging to the Marquis of Conyngham, in the vicinity of the north-west coast. A very extensive bed of excellent white marble is also found near the Erigal Mountains, the highest in Donegal, five miles from Calabbar Bridge.

Passing from the former arid quartzose tracts, bordering Lough Swilly, and crossing the extensive mica-slate ranges of Londonderry, to the eastern borders of Tyrone County, we find a small coal basin in the floetz-limestone. Of this deposit—which contains thirty feet of coal within 120 fathoms of the surface—Mr Griffith observes, that "there is no parallel case in the English coal fields, where such a thickness of coal exists so near the surface." The coal beds, and their concomitant strata, are for the most part disposed at a very high angle. The coal is chiefly used for burning bricks and lime, but considerable quantities are disposed of for domestic purposes. The beds of fire-clay found here are demonstrated by an analysis made by Sir Robert Kane, to be identical in mineral constituents with the Stourbridge clay.

At Coal Island—in the centre of the coal basin—the clay is extensively manufactured into fire bricks, crucibles, &c. A canal of about four miles in length connects this part of the field with Lough Neagh, a noble expanse of water, twenty miles in length, from north to south, and twelve broad, and is at an elevation of forty-eight feet above the level of the sea, at low water. It is the largest lough in the British Islands, and is navigated by small vessels. It communicates by canals, (and railways), with Belfast, Newry, and other places in the surrounding districts.

The tertiary formations which occupy the plain adjacent to the Lough, consist of a series of beds of various coloured clays alternating with grey and white sand. The secondary formations of lias, greensand, and chalk, emerge from beneath these tertiary deposits to the north-west, where they are occasionally overlaid by masses of basaltic rocks. The new-red-sandstone succeeds them to the south-west. Granite and isolated masses of greenstone, chiefly constitute the mountains that separate the two plains of Omagh and Lough Neagh. The eastern and southern part of the former plain are occupied by the Old-red-sandstone, in some places to be seen resting upon the primary rocks.

According to an analysis of the china clay of the Castle Caldwell estate, recently given by the Rev. Professor Galbraith, it contains three and a half per cent of peroxide of iron, and about five per cent of alkalies; but which, on being subjected to a white heat, assumed a buff colour, manifestly showing its unsuitableness for fine porcelain. The analysis, however, of Professor Cameron, of the chemical society, would seem to warrant very different conclusions. He shows that the clay is free from the peroxide of iron, with the exception of that contained in the micaceous particles, which it will not be difficult to get rid of; and the correctness of his opinion would appear to have been verified by the operations of Messrs Kerr of Worcester, who have manufactured some perfectly white cups from this identical clay, though subjected to a very high temperature.

In the counties of Tyrone and Antrim a discovery has recently been made of an extensive bed of coal, the formation reappearing at Cultra, on the county Down shore, about five miles below Belfast.

The discovery of Professor King, proves the magnesian limestone to exist in Tyrone. The Old-red-sandstone was considered to occupy the places now indicated as permian, and to extend from Cookstown to Lough Erne, through the centre of Tyrone, lying to the south of Omagh.

The granite and mica-slate formations of Donegal have, as before intimated, a north-east and south-west range. These primary ridges occupy nearly the whole of the county of Donegal, and very large areas in the counties of Tyrone and Derry; the mica-slate, doubtless, being a continuation of the broad zone which, in the same direction, traverses the Highland districts of Scotland, and forms the elongated peninsula and Mull of Cantyre, whose extreme southern point approaches to within about fourteen miles of the opposite isolated mass of mica-slate on the north-east coast of Antrim; the strata of which, dipping there beneath the patch of limestone at Fair-head, and the chalk and basalts of that country, emerge again to the surface in the county of Derry. It is here worthy of remark, that near Cushendall, on the southern border of the Antrim patch of mica-slate, the chalk reposes immediately on this formation, exhibiting, thus, the disappearance of the clay-slate, devonian, carboniferous, and secondary systems from their assigned geological positions! And presenting a very striking example of the tremendous effect of denudation—as having swept away the entire series, at least, of secondary rocks; subordinate to the cretaceous deposit; unless, indeed, we may suppose they never were deposited in that situation, though from existing circumstances, it is highly probable that they were, or at all events many of the members, or groups, of the geological series we have particularized as being in this particular instance altogether absent.

The mica-slate—which belongs to the metamorphic class of rocks, and is often designated primary stratified—is not uncommonly to be seen in the north-east of Donegal, graduating into granite. It sometimes approaches obscurely to clay-slate, and at others to well-defined gneiss. Mica, the base of the rock, usually decreases in the lower beds, which there become of a more quartzose character. In the locality just referred to, we find, as already mentioned, immense quartz veins, or channels of siliceous rocks often forming high prominent masses and barren ridges. In the hornblendic portions of the schistose rocks, (as in the Scottish range), the precious and common garnet are of frequent occurrence, and occasionally, crystals of tourmaline. The rarer minerals of epedote, essonite, columnar idocrase, and malacolithe, also occur in this singular region of crystalline rocks.

The granite and mica-slate[*] of the north-western extremity of Ireland, generally, constitute mountain ranges of considerable altitude; the largely predom-

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[*] According to Dr Turner's analysis, mica consists of:—

Silica	50.82
Alumina	21.33
Protoxide of Iron	9.08
Fluoric Acid	4.81
Potash	9.86
Lithia	4.05

Mica-schist is composed of interlaminated mica and quartz.

Gneiss—the next rock in descending order, and reposing upon granite—consists of mica, (or hornblende), felspar, and quartz. It is fine grained and laminated, or stratified, and belongs to the metamorphic system. Its varieties are extremely numerous. Gneiss mountains have rounded summits and gentle declivities.

Granite is constituted of felspar, quartz, and mica.

inating elements of quartz and mica, rendering the latter, especially, little liable to decomposition, its stratified masses often present a very rough and serrated contour, rising frequently into abrupt peaks, ledges, and fantastically shaped mountains. A thin moory soil pervades the higher regions of the Derryneagh granitic groups, and the same may be said of the Sperrin, Barnsmore and other mountain ranges of the schistose districts, and which very generally presents a cold moorish aspect. Considerable fertility, however, characterises many of the deep intervening valleys, for the most part running in a north-east and south-west direction; and wherever the schist slate, limestone rocks, &c., form a junction, or where hornblende is pretty prevalent, or trappean rocks protrude, a thick workable, productive soil predominates. These heterogeneous soils, as also those of the transition tracts, arising chiefly from the decomposition of slaty rock, are very well adapted for crops of oats, flax, barley, and potatoes, and which, in this part of Ireland, are very extensively grown. The limestone district about Donegal, possesses a rich and productive soil, varying from a light gravelly earth to a deep mellow loam.

The adjoining county of Tyrone presents a boldly swelling and occasionally mountainous surface, in many parts the soil of the old-red-sandstone tracts is deep, friable, and productive; and for the most part is under an improved system of culture. The districts in the vicinity of Lough Neagh, are somewhat remarkable for comprising within a comparatively narrow compass, the several formations of new red sandstone, old-red-sandstone, micaceous schistose, tertiary strata, basalt, and an elongated strip of granite,—a fortuitous approximation, which has been productive of a rich, deep soil in most of the less elevated situations, and insured a liberal and equable distribution of the chief elements of fertility to an extensive range of country. On the granite and sandstone hills, in the vicinity of Pomeroy, there are extensive tracts of bog and moor. The plain of Omagh comprises the most extensive tract of fertile land in the county of Tyrone, nearly one-fourth of which is unimproved mountain and peat-bog.

The county of Fermanagh, into which these moors extend, is divided into two nearly equal parts, by Upper and Lower Loughs Erne, said to contain the greatest extent of inland navigation of any of the Irish lakes. These fine loughs, which are at a very considerable elevation above sea level, are chiefly bordered by the carboniferous limestone, often constituting here rounded hills of slight elevation; a very considerable tract of the old-red-sandstone trends along the western side of Lower Lough Earn, to within a few miles south of Enniskillen. It presents much diversified, fertile, and pleasing scenery.

The scenery about the head of Upper Lough Erne, is singularly picturesque. The finely wooded demesne of Crum Castle, majestically towering above the gigantic timber which covers the promontory on which it is situated, the remarkable maze of waters composing the head of the lake, with numerous pretty islets, many of which are adorned with rich foliage, and the larger inhabited ones, animated with the usual concomitants of rural life, together form a scene of rich and varied beauty, which well entitles it to the appellation of the "Windermere of Ireland." Considerable tracts of black moor land, occur to the north-east of the loughs, and also to the westward, extending into County Sligo. Flax is extensively grown in their vicinity, and on the whole, an improved system of cultivation has been introduced.

The following impartial observations from the pen of Mr Inglis, will serve to give a good general idea of the state of rural matters in this part of Ireland. He says:—"The condition of the land occupiers in the baronies of Fermanagh is superior to that of the same classes in most other parts which I have visited; but at the same time, looking merely to externals, and especially judging by the houses in which the people live, one would certainly form too favourable conclusions. The love of a neat exterior, which is observable in this district, and in other districts of the north, is not so much the result of superior condition as of *other causes*, the chief of which is that very many of the landholders are Scotch and English by descent, and that the force of example has prevailed. Another reason is, that there are many resident gentry, most of whom are unembarrassed in their circumstances. From attentive observation and anxious inquiry, I have reason to say that the rents throughout this county are from 5s. to 8s. an acre too high with the exception of the old takes. The utmost industry is required in order that a man may pay his rent, and live in any thing like comfort; but in order that there should be an accumulation of capital among farmers, rents would require to be lower. I should certainly say, however, that any industrious farmer occupying a fair-sized farm may be comfortable in this county, though he may not be able to get rich. The produce of an acre of good land here may be worth £8, and at 25s. rent a fair profit is received. I found all admit —both Protestant and Catholic farmers—that they could afford to eat meat three times a week, and as much milk and butter as were required for their families; or, if they chose to live more abstemiously, they could lay aside a little money. One individual, paying 30s. an acre for a moderate sized farm, but of which the land was of the best quality, told me he could afford to eat meat every day. The wages of labour here is usually tenpence, without diet, or sixpence with diet, but day labourers are not common. The usual *practice is to* keep farm servants, who get from £3 to £5 a year. I found a good many small cottars, owning a quarter of an acre or so, and a cabin. These small holdings were under the farmers, and the agreement generally was to give for their holding four days' labour. This is exorbitantly high; it leaves little more than a hundred days' labour for all that life requires, beyond the produce of a quarter of an acre of potato land. The corn acre system is also common in most parts of Fermanagh, and the rent per acre is from eight to ten pounds."

In the more bleak and barren districts of the south and west of County Donegal, the poor are subject to great privations and wretchedness for the want of adequate employment. We have, however, seen that nature has beneficently stored the subterranean recesses of those regions with the elements of prosperity she has so scantily scattered over the surface of the hills. And, they wait only the due application of capital, skill, and industry, to render them the copious sources, not only of relief and comfort to the needy, but of profit and progress to the surrounding community. Instances, without number, might be cited, to show that where mines have been opened and worked to any extent, a very manifest improvement is shortly observable in the general appearances and domestic habits of the neighbourhood. The labourer, mechanic, and tradesman, alike participate in the *substantial* benefits emanating from their presence.

The poor rates become lessened, consumption is increased, and the farmer himself, duly reaping the results, is stimulated to a more effective system of culture, to the ultimate enhancement of the value of the land, and the interests of his landlord. In many cases, villages, and even thriving and populous towns, have sprung into existence, solely from the development of the mineral resources of localities which previously were characterised only by their desolateness and sterility,—the curse of the native, and worthless to the nation.

The paramount position, power, and prosperity of Britain is mainly owing to the vastness and available value of her mineral treasures;* and obviously, her domestic interests can hardly be more effectively served, than by the discovery and due development of these grand elements of success and progress, in every corner of the kingdom in which they may, in any sufficient shape or character, be found to exist. It is then, assuredly, a wise policy, not only of the state, but of the proprietors of mineral lands, to give due encouragement to mining enterprise, and every reasonable facility to the efforts of the adventurer. A spirit of liberality and fairness, is, perhaps, more especially desirable in the *Irish* landlord, for by its adoption he best consults his own individual interests, and more, he very effectively serves those of his compatriots, in thus rendering the first essential, towards the spirited development and useful diffusion of the boundless mineral resources of his own native Isle.

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* The present annual value of our mineral wealth, according to Mr R. Hunt, government keeper of mineral records, is as follows:—Coal, as raised at the pit's mouth, £11,000,000; Iron, £10,000,000; Copper, £1,500,000; Lead, £1,000,000; Tin, £400,000; Silver, £210,000; Zinc, £10,000; Salt, Clays, &c., £500,000; giving the enormous total of £24,620,000. This is the value of the raw material. When the cost of labour employed in converting this mass of matter into articles of utility, or objects of ornament, is added, it will be swelled a hundred-fold. Our *exports* from the produce of *mines alone*, now amount to the immense sum of £27,150,000! Their increase, in this department, during the year ending 1856, was upwards of £6,000,000!

CHAPTER VII.

CHARACTER AND EXTENT OF THE BASALTIC ROCKS OF ANTRIM—GIANT'S CAUSEWAY—CONSTITUENTS OF GREEN-STONE, &C.—SECONDARY FORMATIONS—BEDS OF LIGNITE—LIAS FOSSILS IN BASALT—GYPSUM—DISCOVERY OF BEDS OF ROCK SALT—COAL OF FAIR HEAD—WOOD-COAL OF LOUGH NEAGH—SILICIFIED WOOD—VALLEY OF THE LAGAN—NEW-RED-SANDSTONE—MAGNESIAN LIMESTONE—IRISH OOLITIC SYSTEM—FLAX—LINEN TRADE, PORT, AND COMMERCIAL PROGRESS OF BELFAST.

THE north-eastern extremity of Ireland is occupied (with the exception of the isolated mass of mica-slate on the sea coast, already adverted to), by vast tabular and irregular masses of the basaltic varieties of rock, including greenstones, whinstones, basalts, and traps. The whole series has an aggregate thickness of from 300 to 400 yards; and occupies an area of more than 1000 square miles, comprising nearly the whole of the county of Antrim, and a considerable portion of eastern Derry. It is immediately based on a series of secondary formations, consisting in descending order of thick beds of indurated chalk, green-sandstone, lias limestone bands and blue shale, and new-red-sandstone, as is finely shown in the mural precipices of Cavehill mountain, in the vicinity of Belfast. This *extensive basaltic* region terminates on the northern shore, in the magnificent array of stupendous columnar facades, and many sided angular structures composing the celebrated giant's causeway.

In numerous instances amorphous basalt appears immediately above and below this vast and often curiously articulated array of, for the most part, hexagonal pillars, though polygons of five, seven, and eight sides are of frequent occurrence, the whole phenomena being, in all probability, the effect of crystallization exerted under peculiar conditions, on a large scale. These remarkable operations of nature, here often afford spectacles of the most striking and impressive character; as for instance, at Garron Point, Port Coon Cave, Carrick-a-rede, Doon Point, the Stack, the Gobbins, and the Giant's organ, and are eminently worthy of a visit from the true lover of nature, who may here behold her sportive freaks displayed in every fantastic variety of romantic and sublime scenery :—

> "Dark o'er the foam-white waves,
> The Giant's Pier the war of tempest braves,
> A far projecting, firm, basaltic way,
> Of clustering columns wedged in dense array,
> With skill so like, yet so surpassing art,
> With such design, so just in every part,
> That reason pauses doubtful if it stand
> The work of mortal or immortal hand."

The basaltic rocks, which are essentially siliceous, are mainly composed of hypersthene, quartz, and felspar; and hornblende or augite and felspar, finely grained and intimately combined. But where felspar and hornblende are intermixed, and possess a granitic structure, they form greenstone. These trappean rocks commonly contain considerable portions of red and black oxide of iron, which, where exposed to the atmosphere, appears as a reddish-brown incrustation. There are three distinct beds of these formations, which, as they approach the northern extremity of the basaltic area, become thicker and assume the columnar structure. The more compact masses often contain chalcedony, zeolites, and calcareous spar, interspersed through the rock in small irregular cavities; felspar, porphyries, and pitch stone occupy a considerable area in the centre of the Antrim basaltic region, and large veins of domite and trachyte occur in the north of it; but it would be foreign to our present object were we to go into detail respecting their embedded minerals, or the several varieties of rocks comprising the basaltic masses.

The sub-formations of chalk, greensand, new-red-sandstone, and lias may be seen emerging from under the basalt, and forming a narrow belt along the shore, nearly the whole distance from Belfast Lough to Port Cromelin Harbour, where they rest on the flanks of the mica-slate, and in which neighbourhood, granite, mica-slate, chalk, and trap, constitute the entire series in a single section! A very similar exhibition of the former series of strata, marks the greater portion of the western verge, or Derry border of the basaltic ranges, but are here accompanied by a long narrow strip of yellow sandstone of the upper Devonian system, which rises up in bold contour from beneath them—sometimes attaining an elevation of 2000 feet—and reposes to the westward on the mica-slate of the Carntogher Mountains, with their occasional beds of primary limestone. We must not omit to mention that among the beds of basalt, ochre, and greenstone, constituting the upper trappean series, lignite or wood coal frequently occurs, and also, that frequent examples are to be seen of the liasic beds containing numerous fossils, so completely changed into the basaltic or trappean structure, that they have been represented as basaltic rocks containing shells. The celebrated Portrush rock has been thus described from its very close resemblance to basaltic rock. The phenomena would appear irreconcilable with the igneous theory.

The greater part of this basaltic district is rocky and bleak, but the soil is somewhat remarkable for its fertility, especially in the valleys and sheltered localities; where good crops are produced. The hills often afford some good pasturage; the country becomes less elevated towards the western confines of Derry, near which, however, there are some considerably *elevated tracts*; the mountains appear in irregular groups. Trostan, the highest mountain, is 1809 feet above sea level.

Although we have necessarily no metalliferous discoveries to speak of as regards this vast basaltic region, we must not omit to advert to the industrial products contained in the tertiary and secondary deposits we have exemplified as fringing its escarpments. The upper strata of the new red sandstone, forming the northern shores of Belfast Lough, contain numerous veins of hydrous gypsum, and at greater depths rock salt. The latter was discovered about six years ago, in borings for coal made by order of the Marquis of Downshire. Three beds have already been discovered, the first at a depth of 200 yards, was twenty-two feet thick, and the boring still continued in the third bed. A splendid specimen of this saline rock was deposited in the Dublin Industrial Exhibition.

A short time ago, a local journal, in reference to this important discovery, said:—"Belfast now or shortly will be in a position to supply itself with fine salt! thanks to the Belfast Mining Company. The Duncrue Works, situated at a short distance from the town of Carrickfergus, are progressing most favourably; the mine is at a depth of 600 feet, and its area is at present seventy feet by fifty, in one apartment, without pillars or supports, the height about eleven feet. When tramways, now in the course of construction, are completed, they *will be able to* ship 200 tons of salt daily to

Belfast. Refining works are erecting adjoining the Ballymena railway station, Belfast; sufficient to produce 10,000 tons of white salt annually. These works will be in operation about the end of March. The consumption of Belfast is about 200 tons, and being protected by the channel freight, the company will have it in their power to supply the whole of the local demand. But this is, perhaps, the least advantage to be derived from this undertaking. A steamer has been placed on the Rotterdam and Belfast trade, being the only direct foreign steam trade with any port in Ireland. This has been brought about by this company being able to give salt as an outward cargo. There being little or no other description of cargo for a steamer or other vessel outwards at this port, the trade could not consequently have existed, as, without a cargo one way, no trade could be successfully managed.

"We have reason to believe that this company have it in contemplation to erect refineries either on the coal coast of England or Scotland, or both, which will enable them to manufacture on the most favourable terms, as coals are a most important item in the expense of refining; and in this respect, therefore, the salt manufactures of Cheshire have an advantage over any Irish establishment." Probably, in the course of a short time, the inconvenience here intimated may be very advantageously remedied by the use of compressed peat, as prepared by the processes of Messrs Gwyne & Co., and several other patentees,—an article which "Ould Ireland" can supply in any quantities, and at a cost, it is said, as solidified, of from fivepence to sevenpence per box of twenty cubic feet.

In the lofty cliffs overhanging Fair Head Promontory, some irregular beds of inferior bituminous coal exist, and which were anciently wrought to some considerable extent, and occasionally are at the present time; a wood coal is found in the hills above Ballantoy, six miles from the Giant's Causeway, but being much impregnated with pyrites, it is chiefly used for burning limestone, which is abundant along the shore.

In the thick deposits of clay and white arenaceous strata, supposed to be of tertiary origin, occupying the south-western, eastern, and southern shores of Lough Neagh, wood-coal or lignite occurs in very considerable quantities, and is much used for domestic purposes. The wood is considered by Dr Lindley to be either the common fir (***Pinus abies***), or the Weymouth pine. Coal of this kind is found in thick beds at Bovey Tracey, near Exeter; it also extensively exists near Cologne, where it is fifty feet in thickness, and is covered with a bed of gravel, from twelve to twenty feet deep. This tertiary lacustrine deposit on the margin of the lake is of great thickness, but though the most extensive in Ireland, occupies an area of very limited dimensions. Numerous specimens of silicified wood are found associated with the lignites, both in the above situations and some three or four miles from the Lough, where they often occur in beds of gravel and clay, containing fragments of trap and chalk, and are, for the most part, covered by accumulations of alluvial detritus of considerable thickness. Ferruginous conglomerates and nodular masses of iron ore are also common in some of these superficial deposits.

In the fertile and delightful valley of the Lagan, repose the subordinate strata of new-red-sandstone, and a series of liasic depositions, composed of argillaceous nodular limestone, and thin bedded lithographic slate, interstratified with blue clay beds; the whole resting to the eastward on the Greywacke slate of County Down, and to the north, disappearing (together with a long strip of indurated chalk, which there overlaps them) beneath the basaltic ranges of Antrim. It is the permian, or lower beds of the sandstone, which are so fully developed here; they generally maintain a very uniform structure, and incline slightly to the eastward.

Beds of magnesian limestone are interstratified with the sandstone on the shores of the neighbouring estuary; and considerable quantities of it have been shipped to England for the extraction of the magnesia it contains. According to Dr Apjohn's analysis it consists of carbonate of lime 16.73 carb., magnesia 11.37, peroxide of iron and silex 1.47, water and loss 1.43=31. The sandstones and accompanying strata are much intersected by trap dykes, and it has been remarked that in one or two instances, where the trappean or greenstone mass appears in contact with the limestone, it still retains its carbonic acid, thus militating against the received doctrine of the originally *fused* condition of the former rock. The sandstone hill of Scrabo, 538 feet high, near Newtown Ards, is capped with a mass of greenstone.

The secondary deposits we have been considering, constitute the only representatives of the Oolitic system in Ireland; a circumstance, by the bye, considering its vast central tracts of limestone especially, decidedly in its favour, in an agricultural point of view, as compared with England; large proportions of the midland and southern districts of which, being traversed by the broad zones of cold humid lias, Oxford, Wealden, and other clays, Hastings and Bagshot sands and gravel, and the like. Though it should not be forgotten, that the surface of *these* great formations has been subjected to great modifications from diluvial action; immense areas being frequently occupied by adventitious marls and other superficial accumulations.

Our agricultural notices of the Antrim region will be found in the ninth chapter; but as flax growing and the manufacture and bleaching of linen, is, as in the adjoining county of Derry, the staple trade of the country, we may appropriately introduce here a few remarks from Mr Mulholland on this great industrial feature of Belfast. He says, "Lord John Manners, is the largest flax and linen manufacturer in Belfast, and carries on the manufacture in all its gradations except the weaving. The first stages of preparing are performed in his mills, the yarn is then woven into linens at the people's own cottages, and then bleached at the works. One yard of flax is, in six operations, produced into 13,000 yards. No young people under fourteen years are employed in these mills, and thus all trouble from the educational clauses of the factory act is avoided. Mr Mulholland's chief markets are in the West Indies and South America, where linens are preferred for nearly every article of dress. The passion entertained by the Spanish race in both worlds for linens is remarkable, and Mr Mulholland was anxiously hoping for a revision of the Spanish tariff, which would open that important market to a legitimate supply of Irish goods. Will it be believed that his ordinary annual expenditure for coloured paper and other ornaments wherewith to decorate the bales and packages is £5000? The Courtrai flax is esteemed the best, the Dutch next, and then the Irish, but the latter is principally used. Considerable attention is paid to the social and moral welfare of the work-people in this establishment, and several of the best public charities of Belfast have been originated by one member of this remarkable firm."

Belfast is the great depôt of the linen trade of the north of Ireland, as well as the chief seat of the manufacture. It is the fourth town in the kingdom in extent and population, the third in general trade, and the second in science and literature. The town, which is environed by much interesting, rich, and varied scenery, is most advantageously situated for trade and commerce, at the head of its fine lough, and on the western borders of the estuary of the river Lagan; the principal streets are spacious and well laid out, and, as has been correctly remarked, Belfast, as a large manufacturing and seaport town, unites industry and elegance with cleanliness and social order.

The shores of Belfast Lough are finely diversified by scenery of a soft and rural character, the lands are fertile and well cultivated, and often pleasingly adorned with villas and country seats. The elevated tracts extending for seven miles along the eastern borders of the lough present these features in charming variety, and greatly enhance the beauty of this approach to the town, and in the vicinage of which are numerous attractive rural resorts, sea-bathing retreats, and romantic villages. The range of hills, which partly encircle Belfast to the westward, constitute some of the most pleasing and diversified scenery of the neighbourhood. Cave Hill, the most prominent eminence, is a place of considerable resort during the summer; from its summit the varied beauty of the surrounding neighbourhood is seen to great advantage, and beyond which appear the Mourne Mountains, the elevated and undulated districts of Antrim, with glimpses of some of the valleys traversed by its rivers, many of which are remarkable for their romantic and picturesque scenery; views also of the higher hills which skirt the coast, the Isle of Man, and several parts of the coast of Scotland, are also obtained.

The commerce of the port has of late years greatly increased in extent; the most important branch is across the Irish Channel. Upwards of twenty steam vessels ply regularly between Belfast and London, Glasgow, Liverpool, Whitehaven, Carlisle, and Dublin. There is also an extensive trade with the United States of America, and Canada, Baltic, Archangel, West Indies, and Mediterranean, and of late a limited trade to China. In 1846, the Tidal Harbour Commissioners pronounced Belfast "the finest town in Ireland for enterprise and commercial prosperity;" and in 1850 its port revenues had increased to £29,000,000. Belfast, which in 1841 contained above 75,000 inhabitants, had risen in 1851 to near 100,000—showing an increase of upwards of 24,000!

Belfast, in short, is in every way worthy to be designated the capital of Ulster—a Province, which has been pronounced by one of its gifted sons, to be at least fifty years ahead of its sister Provinces, in all the true *elements of* National greatness.

THE FOSSIL ELK OF IRELAND.

CHAPTER VIII.

Striking Evidences of Diluvial Action—Fluviatile Action—Lacustrine Deposits—Fossil Remains of the Irish Elk, &c.—Remains of the Existing Genus, Cervus, in Tertiary Strata—Extinct Species—Mixture of Human Bones with Remains of Extinct Mammifera—German Scientific Association—Man and the Mammoth Contemporaneous—Absence of Human Remains in Regular Strata—Abundant Animal Remains in Pliocene Strata—As also in Diluvial Deposits of England and other Countries—Baron Cuvier's Testimony—No Recognised Traces of the Deluge—Startling Considerations—Partial Deluges—Duration, &c., of Noachian Deluge, which was neither "partial" nor "tranquil"—Pye Smith's Interpretations—Dr Kitto on the Deluge, &c.—Geological Confirmations of Scriptural Truth—Geological Difficulties only Apparent.

In the secondary and tertiary districts in the vicinity of Lough Neagh, but more especially throughout the great Greywacke zone, of Downshire, &c., the most striking evidences of diluvial action are afforded. And the *newer Pliocene*, or upper members of the tertiary and the more recent sedimentary deposits to the north, are often, apparently, so blended and so analogous in their more general physical characteristics as to render it almost impossible, where the fossiliferous indices are absent, to draw any line of demarcation between many of the several accumulations, or to determine their true geologic character and position. The most remarkable feature, however, is the tremendous nature of the diluvial action, as evidenced by the magnitude and distribution of the superficial deposits, in the Silurian districts, and to which we shall have occasion to allude in treating of that important formation.

Fluviatile action, also, often effects great ravages, and is a powerful agent in the distribution of detritus, particularly on Continents, where mighty rivers often become suddenly inundated by rains and the melting of snow upon Alpine ranges. But, if such impetuous floods sometimes prove a partial evil, they are, on the whole, of immense benefit in the economy of nature, by bringing down from remote situations, the disintegrated, fertilizing ingredients of variously constituted rocks, &c., and spreading them over vast tracts of country. And the exuberating effects of such natural renovations are frequently very manifest along the borders of the principal Irish rivers.

In many localities in Ireland, beds of whitish marl *occur,* which appear, for the most part, to be lacustrine deposits, occupying small depressions in the limestone, or in the alluvial tracts, and are not unfrequently encrusted over with peat bog; it is in these calcario-argillaceous beds, that the horns and osseous remains of that extraordinary extinct animal, called the Irish Elk, are more commonly found; and in similar situations, have also been discovered, a rib of one of the deer pierced with an arrow hole, a human skeleton, and implements of chase, teeth of the horse, and the rib of a whale. Near Drogheda, the antlers of the Fossil Elk, have been dug out of a bed of marl, and which measure from the extreme tip of each horn ten feet, ten inches. There is a perfect skeleton of this species in the Museum of the Royal College of Surgeons, Edinburgh. The skeleton in the museum of the Royal Society at Dublin, measures in height to the top of the back six feet, six inches, and the distance between the tips of the horns, is eleven feet ten inches. Fossil remains of the Elk have been found in the Isle of Man and in a great part of Europe.

The great Mastodon has been found in the marshes and *peat bogs* of Kentucky; and Dr Dickeson, of Natcher, America, affirms that the fossil remains of man, have been found in that neighbourhood, embedded in blue clay beneath the diluvial drift containing bones of the Megalonyx. Bones belonging to Stags and Reindeer are of common occurrence in the caverns *of South* America, as well as those of Europe.

At a late meeting of the Academy of Sciences at Stockholm, a letter was read from Professor Melson, in which he stated that in a bog at Ysted, and Folsterbo, near Beddinge, he found several human bones mixed with immense fossil remains of horses, stags, bears, and elks; and also a large number of arrows, lances, heads of bone, and flint. On various parts of the Continent, according to Cuvier, the bones of the gigantic Elk, occur in the same strata with the bones of elephants.

Although the subject of fossil remains does not exactly come within the scope, or province, of our present dissertations, we trust, the important and very interesting considerations necessarily involved in these singular osseous discoveries, will warrant our dwelling with some particularity on their character and associations. The geological positions, that the deluge was 'a partial and tranquil flood,' and that human bones have not been found with the remains of primeval mammifera, having long been pertinaceously maintained, by, as it would appear, a too hasty rejection of all evidence, demonstrative of a contrary belief, invests the character of the discoveries in question with an additional and peculiar interest.

Although it would appear, that the fossil Elk has very commonly been found in tertiary beds and assigned lacustrine deposits, there are, as we have already seen, other circumstances that seem to warrant the conclusion that man and the fossil elk were, at some period, destroyed by the same catastrophe. Certainly, the remains of Testacia have been found with those of the Elk of Ireland in the diluvial beds of the country. Palæontological writers affirm that a great many fossil species of the existing genus, *Cervus*, are found in the falurian, subappenine and diluvial stages of both Continents; and no less than eighteen species in the Miocene (or middle tertiary strata) of Eppelsheim and Sansan, the colossal horns of one individual (analogous to the Irish elk) having a span of more than nine feet from point to point. Remains of deer are numerous in beds of the third period of the tertiary series, and in caverns.

Dr Buckland found evidences of at least three species of deer, one of very large stature, in the limestone cavern of Kirkdale, Yorkshire, associated with bones of the mammoth, tiger, elephant, bear, rhinoceros, hyena, ox, horse, and even those of birds and rats. The fossil remains of most or all the above genera, together with human bones, *all below a layer of stalagmite*, are met with in the well-known Kents Cavern, near Torquay, Devon. The osseous relics of deer occur also in the caverns of Germany, with the bones of the hyena and the rhinoceros. The fossil remains of lions have been found in the caverns of Franconia, &c. Those of hippopotami not only occur abundantly in the tertiary series, but are frequently discovered in beds of sand, gravel, and clay, termed by some diluvial, and are also found in the ossiferous caverns and osseous breccia.

But, the more forcibly to elucidate the position that these fossil animals—Mammalia, &c.—lived before the existence of the human race, great prominence has been given to their being the remains of *extinct species;* that many of them are so, appears unquestionable, but it is also undeniable that the most eminent anatomist has not been able to discover any difference between the present *wild cat*, and that which lived with the hyena, bear, horse, tiger, elephant, rhinoceros, hippopotamus, ox, deer, hare, rat, mouse, &c., whose remains are found in the limestone caverns, &c. The fossil otter and badger, it has also been shown, have a precisely similar organization to the species at present living; it would therefore appear that no very decisive or important inferences can be adduced from the fact of finding, under such circumstances, certain extinct species; that species of modern date do occasionally become extinct, that of the Dodo, approaching our own time, is a notable instance.

In the caverns of Bize, and those of Sommieres, &c., in France, there is an incontestible mixture of human bones with bones of mammifera belonging to extinct species. Tournal, who enumerates nearly forty species of animals, and all the larger ones, besides birds, lizards, and snakes, concludes from the state of the bones, that they are *antediluvian*, and that before the last general catastrophe, southern Gaul was inhabited by man, together with a great number of species of mammiferous animals now extinct. Some recent discoveries have proved that the *extinct animals* had for their companions species which still subsist:—the remains of the musk ox, the urus, and the red-deer, are found in the same position as those of the elephant and rhinoceros.

The Aurochs, Zubr, or European Bison,—a male and female of which are in the Gardens of the Zoological Society, Regent's Park,—once roamed over the primeval forests of all Europe, and in Britain, according to Professor Owen, was contemporary with the races of elephant, rhinoceros, tichorhine, mammoth, and other extinct animals of the Pliocene period. It is now only found in the forest of Bialavieja, Lithunia, where it is carefully protected by the Russian government.

A most interesting discovery of fossil bones has recently been made at Pekermi, a village which stands at the south-east foot of Pentelicus, in Greece. A large collection of them has been brought to Paris by Messrs Lartet and Gaudry, and described in a memoir submitted to the Academy of Sciences. They represent a singular variety of species; the collection in cludes—a monkey (semnopithecus), a hedgehog, two giraffes (one taller than the living species), a huge Edent quadruped, resembling the sloth in form, and as large as an elephant, with various bones of gallinaceous *birds, but no* fishes or reptiles. Since the finding of these bones, Dr Roth, a Bavarian, has collected on the spot a large addition to the above-mentioned, including remains of no less than nineteen different species of quadrupeds, thirteen of which are considered new. The bones were much broken and disseminated, and no complete skeleton was found. The deposit in which they were imbedded, is considered to belong to the Miocene or lower Pliocene.

It is hardly possible to conceive that the antelope, the giraffe, the ox, the monkey, the horse, the hog, and the goat, would be found associated with the rhinoceros, the wolf, the hyena, the lion, and the mastodon, on a single mountain, so circumscribed in extent as Pentelicus, which is only about ten miles long and three broad, with an elevation not exceeding 3000 feet. And, indeed, it appears that Messrs Lartet and Gaudry—considering the heterogeneous character of this Fauna, and being found in so limited a space, or even though they belonged to the whole peninsula of Greece—have come to the conclusion, that they are the remains of the denizens of different countries and different climates.

A still greater variety of similar fossiliferous remains—investigated and described by M. Lartet—have been found in a small lacustrine deposit at Sansan, resting on the northern skirts of the Pyrenees. Among the quadrupeds are nearly all those found *fossil over* the rest of France, and representatives of nearly all the mammalian family. This singular osseous collection is, like the Pekermi bones, the more remarkable, that belonging to such dissimilar races, they should be found on a spot so circumscribed in extent as that of a small fresh water lake.

As additional evidence of a very confirmatory character, we may state, that at a meeting of the German Association for the Advancement of Science, held at Tubingen in 1852, the great fact elicited, as formerly announced, was the clearing up of the mystery of the fossil human teeth exhibited at the preceding year's meeting, which were found in the Swabian Alps, in strata of the mammoth period, and doubts expressed as to their being human teeth, from a disbelief that man existed in the time of the mammoth. Since the meeting of 1852, however, a number of perfect human skulls have been found in the same locality, with teeth in them.

Mr Bakewell, whose geological writings are so highly and deservedly appreciated, says, "I have part of the tooth of an elephant, which, in the handwriting of Faujas St Fond, is said to have been found at Montmartre, and is evidently from the marl beds. Here, then, we have the remains of an animal of the most recent tertiary age, occurring in a formation more ancient than the age of mastodons. Such instances," says he, "should lead us to receive the evidence from *animal remains* alone, with much caution."

The bones of the mammoth have been found in the diluvial soil near London, Northampton, Gloucester, Harwick, Norwich, on Salisbury plain, and in other places in England; they also occur in the north of Ireland. It is also worthy of remark, that a mammoth's bones have been found at North Cliff, Yorkshire, surrounded by thirteen species of fresh water shells, *still found in the district.* Some of the lower hills of the Appenine chain contain, among many species of shells, the fossil bones of elephants, of the rhinoceros, of the hippopotamus, of *whales*, and of *dolphins.* In Corsica, the limestone fissures and caves contain the bones of small quadrupeds, chiefly foreign to the place; as those of one inhabiting the coldest and wildest parts of Siberia. Many of these facts, not only strongly testify that a race of human beings was in existence contemporaneously with the elk, mastodon, and certain other of the large antediluvian animals, but that the mastodon, &c., existed at a much later period than is generally admitted.

True it is, however, that the bones of man have not as yet been discovered, even in the most recent of the tertiary series, and hence, the positive assumption of many geologists that man was not in being during the tertiary epoch; or, indeed, even during the *diluvial periods.* But ere participating in a tenet of this dogmatical, and we are inclined to believe, premature *character,* it may be well to reflect, that not very many years ago, before any osseous relics of the Simiadæ, or monkey species, had been recognised, it was confidently affirmed by many a gifted palæontologist, and astute inquirer, that their remains never would be found in a fossil state, their creation being thought to be coeval with that of the human race; still less was it imagined that proofs would be discovered of their former existence in this Island. At length, however, (in the year 1839), a discovery made at Kingston, close to the town of Woodbridge, Suffolk, effectively dispelled this illusion. Part of the jaw of a monkey in the fossil state, with the remains of other animals, was found in a brickfield at that place, in the occupation of Messrs Cobbold and Colchester, and was duly chronicled and described by Professor Owen, in the Magazine of Natural History, for September in the above year, and who stated that the monkey must have belonged to a species differing from any now in existence.

In the Year-book of Facts, for the present year, it is stated that M. Fontan has discovered, in the south of France, a new fossil ape, allied to the chimpansee or ourang-outang, to which the name ***Dryopithecus Fontani*** has been given. It is supposed to have been frugivorous, and to have inhabited trees. And it is also authoritatively affirmed, that there are now, therefore, six fossil apes in Europe—two in Britain.

And, *considering* the vast extent of this thickly peopled area, the innumerable upturnings to which its surface for ages has been subjected, and the hosts of intelligent investigators, who, for the last twenty or thirty years especially, have been eagerly ransacking not only Europe, but almost every part of the explored regions of the globe, for fossils, it is a marvel, that up to the present day, we have only this meagre catalogue of Simiadæn fossil remains. Even they, however, sufficiently testify to countless tribes of these animals having occupied, during untold ages, the boundless forests of the primeval world. And yet, these few solitary relics, of their half-dozen representatives, arose not from their fossil tombs, until after the grave philosopher of the nineteenth century had formally announced—from their non-appearance—that "like man" they were not in being during the era of gigantic mammals, amongst whose remains they are now found. Perchance, the monkey thus, may herald in the man.

Again, from the well-known paucity of the remains of animals of every grade, distinguishing the sandstone strata, it might as well be inferred that organic beings were not in existence during the epoch of their deposition. The absence of such remains is peculiarly remarkable in the arenaceous strata of the Old-red-sandstone, the millstone grit, and in the New-red-sandstone, although they lie upon others that do contain *them, and* often in great abundance. The accidental discovery, in a few localities, of the mere *footprints* on strata of the latter formation, of reptiles (as of *Cheirotherium*) and birds (*Ornithichnites*) first annulled the geological position that air-breathing vertebrata were not of such high antiquity as the New-red-sandstone period. The isolated impressions above named, are, in fact, the only recognised evidence of the existence of these races at that remote epoch, and of which, though they doubtless existed in countless multitudes, and although the New-red-sandstone was being deposited during their era, and obviously often in their peculiar haunts, we find not a fossil remnant, not a single trace of their organic structures throughout the whole of the strata of that immensely extensive formation! How little then, can we be warranted in assuming the non-existence of any races of beings, even at any similar geologic period, simply because the rocks, or even adventitious deposits, appear to contain no vestiges of their organic remains?

It has been well observed, the country that could give support to the mammoth, or ancient elephant, to the mastodon, and the elk, might, for ought we know to the contrary, be also suited for the residence of man. Besides, the patches of tertiary strata occupy, comparatively speaking, but very inconsiderable areas of the earth's surface, and they, in point of extent, have of course been only partially explored, and at the *early period* of their deposition, men might not have been settled in the countries inhabited by the numerous animals whose remains have been found in the tertiary strata. But, however, this might have been, the completeness, the often apparent suddenness, and the *universality*, which marked the destruction of the latter during the later tertiary, and *diluvial* epochs, is very striking.

The Pliocene periods abound in elephants, mastodons, mammoths, and other Pachedermata; also in oxen and large deers, or elks, hyenas, bears, &c., many of the animals being of the same species with living races. Elephants' bones have, as already mentioned, been found in the diluvial of almost every county in England; they, together with hippopotami, &c., are very plentiful in water-worn debris on the plains of Middlesex; vast quantities of elephants' tusks are found off the Norfolk Coast, and similar remains have, indeed, been largely discovered in almost every part of the globe. In a conglomerate of muriate of clay, resting on the southern declivities of the Himalays 10,000 feet above the level of the sea, there have been found bones of extinct species of many small and large mammalia and fish, with fresh water shells.

Germany and Switzerland appear particularly to abound in remains of the elephant, &c.; in Norway, Scandinavia, Russia, Iceland, and Siberia, they are *remarkably* plentiful; many of the Islands in the

Arctic Seas, are full of the bones of elephants and rhinoceros; those situated opposite to the Lena are said to be almost composed of them and fossil wood. Pallas says, that from the Don to the Tchutskoiness, there is scarcely a river that does not afford the remains of the mammoth, and that they are frequently embedded in alluvial soil, containing *marine* productions. In an ice bank near the mouth of that river, the mammoth, referable to those found in England, &c., was discovered with its skin, hair, and flesh in a state of perfect preservation! a proof that it must have been frozen as soon as killed, or directly it was lodged where found.

It is worthy of remark, that although, in some instances, the carcases of animals occurred nearly whole, entire skeletons are seldom found, but mostly separate bones, widely dispersed; and it is said that between the countries now inhabited by these animals, and some of those in which their bones have been discovered, there are chains of mountains exceeding 9000 feet in elevation. *The remains of the animals which are found in the newest of the deposits of gravel, sand, and clay, have been found in the countries above cited, under circumstances so nearly similar, as themselves to induce the belief that the earth has suffered by an universal inundation.*

Such facts, and discoveries, all indeed, forcibly demonstrate that the catastrophe which destroyed the animals, *must* have been both *sudden* and universal.

Baron Cuvier, in speaking of the sudden nature of former convulsions, says:—"*This is especially to be proved with regard to the last of these catastrophes; that which by a two-fold motion has inundated and afterwards laid dry our present continents, or at least a part of the land which forms them at the present day.*" He concludes, that the then existing races of animals were destroyed by it at one and the same time. Thus bearing the strongest physical testimony to the veracity of the Mosaic Record.

These inductive declarations, resulting from the actual investigations of a naturalist so eminently celebrated, are in themselves sufficiently satisfactory, and here we would gladly pause. But, as regards the views ordinarily entertained,as to the geological results of the last grand cataclysm, which Holy Writ declares was designed to overwhelm the world and its inhabitants in one common ruin, they meet with little or no scientific response! Amid all the geologic divisions and subdivisions to which not only the tertiary, but diluvial deposits have been subjected, and to each of which class formations, a different and a distinct Neptunian origin is assigned, the last mighty catastrophe whose flood-tides were summoned by the Almighty fiat to "destroy the earth," has not one geological representative!

Leaving, however, such deductions to be their *own exponents* with regard to such apparent anomalies, and which, by the bye, may perhaps, be conducive to, or heralds of, grand discoveries, and requesting our readers to bear in mind the foregoing statements, we seriously commend to their reflection the following startling considerations:—"In the 1656 years directly preceding the flood, that is, one-third of the entire duration of the world since it was first tenanted by man, millions of beings must have existed, nations and dynasties must have flourished, cities were built, and arts prevailed, events sufficient to have filled huge libraries with their history must have happened, and it must have taken volumes to have recorded their civil polity and warfares,—yet all that we know of them is contained in a few pages of the Book of Genesis, where a few heads of families merely are mentioned, to deduce the genealogy of Noah from Adam. The antediluvian population at the time of the Deluge, supposing that the rate of increase was, on an average, similar to that immediately succeeding that event, must have equalled, the population of the world at the birth of Christ.

"It is unreasonable to suppose that the primeval population was confined to some extensive valley, some extended country, or even to a single continent. They, no doubt, like the post-diluvians, went forth and peopled the earth, founding great nations, and erecting many monuments of human art; yet not a trace of all these is to be seen, not a mound, or a brick, or a lettered obelisk, or even a scratch on a durable rock, which can be called antediluvian. No mines, or quarries of the earth, no workings above ground or below, not a tomb or a tumulus, not even a bone of our remote progenitors, has ever yet met the astonished gaze of inquisitive mortals; yet tradition is full of the event of their existence, and the awful catastrophe of their destruction, even in the remotest corners of the earth, and among the rudest savages, who separated thousands of years ago from the central focus, still retain these traditious in their memories, and mould them into their religious observances. No fact can be better established than the destruction of a primeval race by the Deluge. Profane history has repeated allusions to it, Sacred History confirms it." *

It is not for us to enter here, even did our limits permit, into any discursive inquiry, on the highly interesting and important points, involved in the alleged, inexplicable, disappearance of all antediluvian vestiges, as above enumerated, and their relation to geological positions. But, for a moment, let us glance at the question under one or two of its main considerations; the apologists for the intervolved discrepancies, suggest that the deluge was a "tranquil flood," and consequently effected little or no alteration in the contour and disposition of the earth's surface; but, granting

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* Physical History of Man.

even this, we should certainly expect to find some of the innumerable relics of living nature above referred to, entombed (during the 1656 years) on the borders of large rivers, in the deposits of ancient lakes, estuaries, or plains, (by causes in constant operation, as taught in Sir C. Lyell's "Principles of Geology,") but even in such very probable situations, none, regarded *as such*, it seems, have as yet been discovered. And indeed, even the disrupting, denudating, and transposing effects of an *un*tranquil deluge, leaves us, *geologically* also, without any fossiliferous evidences of this *antediluvian* character.

The present dry land bears but a very small proportion to the watery surface of the globe; may it not be probable that the briny flood now flows over most, not to say all, of the regions which were dry land during the antediluvian ages? "By the deluge," says Baron Cuvier, "was caused the disappearance of countries formerly the abode of man and animals, now known to us; that the bottom of the sea at that time was left dry, and upon it were formed the countries now inhabited; and that since that epoch, the few of the human race who were spared have spread themselves over the world, and formed societies." This eminent naturalist, also expresses his belief that countries now inhabited, and which that great catastrophe left dry, had been at some former period inhabited, the *abode at least* of land animals, which were destroyed by some previous deluge; and that they had even suffered two or three such visitations, which destroyed as many orders of animals.

That transient floods, at different eras of time, have swept over various divisions of the earth's surface in the latter periods of its history, dealing death and destruction in their impetuous progress, we have perhaps, abundant proofs in the enormous distinctive accumulations of detritus, to be seen on every hand, in almost all countries. But, from the declared character, and denudating power, of the Noachian deluge, it would appear pre-eminently calculated to produce effects *vastly more extensive* and *tremendous.*

It has been well remarked on this point, that "whatever may have been the form of the surface of the earth before the universal deluge, that awful catastrophe must have been a powerful agent in forming its present surface. The figure used by Moses in describing the intensity of the rain, 'And the windows of heaven were opened,' shows us that we have no idea of the quantity of rain fallen in a given time, nor of the effects which it produced; but if we suppose that the rains equalled only what is frequently seen in the *tropics*, and judge of its effects from the length of time which 'the windows of heaven were opened,' (when the rain fell not in drops but in cataracts), we may easily conceive the effects were *most terrific.* Tearing up, and carrying away every-thing before it; the surface would first give way—the vegetable mould would be carried down—and as the level of the sea arose, the lighter parts would be deposited where the rapidity of the current was stopped by meeting the level surface of the water; and this would go on, till the water arose to the highest point."

Producing, in fact, effects, now almost every where most apparent, and which, most certainly have not, generally speaking, been derived from "causes at present in operation." That varied, bold, and abiding configuration of surface, arising from the vast conterraneous beds of adventitious clays and gravelly debris, the huge talus so commonly to be observed forming the eastern slopes of *isolated* mountains especially, and the numberless denudated valleys, all afford evidence of the most convincing kind, that the last flood-tides which swept over the earth, were of the most powerful and devastating character.

The writers who advocate the theory of a "partial deluge," not unfrequently urge as a powerful objection to a "universal deluge," the insufficiency of a natural supply of waters to cover the tops of the highest mountains; and also, somewhat triumphantly, ask what has now become of the surplus waters of the Noachic flood? Notwithstanding, when the speculative geologist desires to account for any observed geologic phenomena, he rarely hesitates to evoke some adequate *and startling* hypothesis,—from his Tartarian depths vast mountain chains arise, or, perchance, Neptunian floods break their "set bounds," and usurp the wide dominion of the hills.

Mr Hugh Miller, whose late disquisitions in favour of a "partial deluge," are now before the world, tells us, in a former publication, and we think very justifiably, that by the *power* of *denudation*, a deposition of the Old-red-sandstone, full 3000 feet thick, in the western districts of Ross, has been swept away, and the gneiss rocks on which it rested laid bare; the same gifted writer also affrms that denudation, to an extent equally great, has taken place in the Scotch coal field; "Lunardi," says he, "in his BALLOON, *never reached the point, high over Edinburgh*, at which, *save for the waste of ocean*, the coal seams would at this moment have lain!" And then, he asks:—

"Who was it scooped these stony waves?
Who scalp'd the brow of Old Cairngorm?
And dug these ever yawning caves?
'Twas I, the *spirit of the storm*."

We doubt it not; nor can we likewise fail to perceive, that these tempest driven surges of ocean, which so rudely scalped the brow of Old Cairngorm, and avowedly, rode rampant *hundreds of yards* above the rocky crests of the highest mountains in Britain, o'er-topping, perhaps, the silvery cone of Arrarat, must assuredly, have at least been those of a Ducaleon flood, *if not*, indeed, a veritable Noachian cataclysm! And therefore, we in turn may well demand, whence came *these ærial floods* of the *geologist*, and to whither are *they* fled?

Especially, we should not be unmindful, that the great Mosaic event was a deviation from, or rather a violation of, the ordinary laws of nature, and not one of a necessary sequence of events; that, in short, it was effected by *the extraordinary interposition of Divine Power*. For the especial accomplishment of His *revealed will* on this awful occasion, "the windows of heaven were opened, and the fountains of the great deep were broken up;" "the waters prevailed exceedingly upon the earth, and all the high hills that were under the whole heaven were covered," the turgid turmoil of waters *prevailing*, or in other words, collectively continuing their prolonged swell over the face of the globe for a period of upwards of 370 days, and then, as continually retiring, or rather hastening before the "wind,"—which the Creator made "to pass over the earth,"—into their "set bounds." And who shall presume to calculate the revolutionizing or transposing effects of this mighty inundating advance, and recession, of the oceanic waters, under circumstances so peculiar, so appalling? Who can confidently affirm that the present wise and beautiful disposition of sea and land, was not, in some considerable degree at least, then *accomplished through* the agency of such tremendous action, and the accompanying signified disruption, depression and elevation of strata? Inductive science is comparatively silent on this point; it is in fact one of Nature's hidden mysteries, known only to the Omnipotent Architect, who "shut up the sea with doors, *when it break forth as if it had issued out of the womb.*"

Such interpretations of the sacred text are, however, too literally rendered, to meet the demands of the dogmatism of the day, based on the physical evidences presented by the more recently recognised geological phenomena, which have just claimed our attention, and which doctrine, be it observed, is only reconcilable with the supposition of a local or "partial deluge;"—an admission, Dr Pye Smith is inclined to believe, warranted by the style very common to scriptural phraseology, their being, he says, "no rule of interpretation more certain than this, that ***universal terms*** are often used to signifiy only a ***very large*** amount in number or quality." And hence, is it thought, that the idiom of the sacred narrative concerning the flood, does not oblige us to understand a literal *universality*. It may be so. But all recourse to such conciliatory interpretations, the more forcibly suggests, how transcendantly important, is the exercise of the utmost circumspection, in any endeavour to divine or depict the true spirit and meaning of any *passage in* the sacred writings, so as to satisfy, in a measure, at least, the requirements of ***human systems***, or to remove, otherwise insuperable difficulties, however solidly such systems may appear to be founded, on physical facts, as displayed in "the wondrous works of Him that is excellent in knowledge," and "whose ways are past finding out."

We have a striking illustration of the importance of these considerations, in the liberty taken by some scientific writers of the day, with the six Scripture days of creation. These are boldly pronounced by them, not to be natural days, but geological epochs, each of millions of years' duration. Now, it is truly said, that Scripture is its own interpreter; and, perhaps, we cannot obtain a correcter view, a more just appreciation of the meaning of the inspired phrase, "And the evening and the morning were the first day," than that which is so definitively recorded in the following verse:—"And the waters decreased continually until the *tenth month:* in the *tenth month*, in the *first day* of the *month*, were the tops of the mountains seen." "From this text, we learn," says the eminent commentator, the Rev. Dr Stebbing, "that the *years* by which time is counted in the Mosaic narrative, were of *the same length as those by which it is at present divided.*"

As regards the momentous question under consideration, the learned and pious Dr Kitto makes the following *pertinent* observations:—"It has been much urged of late, that the deluge was not universal, but was confined to a particular region which man inhabitated. It may be admitted freely, that, seeing the object of the flood was to drown mankind, there was no need that it should extend beyond the region of man's habitation. But this theory necessarily assigns to the world before the flood a lower population, and a more limited extension of it, than we are prepared to concede. Our reasons for believing the world to have had a large and extended population before the flood, have already been given.* Let us now add, that when we consider how widely the population descended from Noah had increased and spread within a period after the flood greatly shorter than that from the creation to the deluge, with advantages very far below those which the antediluvians possessed, it is simply incredible that it should at the time of the deluge have been confined within the limits required. It appears to us, that a plain man sitting down to read the Scripture account of the deluge, would have no doubt of its universality; and although our interest lies not in reasoning upon the greater or less probabilities of the case, but in ascertaining what the Word of God means to teach us—it is gratifying to believe that

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* "We have already intimated our belief, that no materials exist for any exact calculation of the population of the antediluvian world, seeing that there may have been then, as there always have been since, some disturbing or counteracting forces by which the laws of geometrical increase are in part neutralized. Nevertheless, making the largest allowance for the possible operation of such disturbances, it is difficult to suppose that, where the deaths were so few in proportion to the births, and where the circumstances were probably at least as favourable to the natural development of the population as they are in America at this moment, it may seem a moderate calculation to assume that the world was, at the time of the deluge, scarcely less populous than at present. This is but allowing for the population before the deluge a rate of increase but twofold greater than it has been since—although the duration of life rendered the advantages for increase manifoldly greater. The brevity of the historical narrative, and the fewness of the generations which cover the space of time, tend to prevent us from realizing with distinctness the great duration of the period between the creation and the flood. We forget that it exceeds by more than 400 years the length of the period from the birth of Christ to this day—that is, according to the longer or Septuagint computation, which is generally regarded by chronologers as the most correct; but even the shorter computation makes the period little more than two centuries less than the *time since* the birth of our Lord—a vast period of time, during

which the whole face of Europe, and of a large part of Asia, has been changed—and nations have grown to greatness which were at its commencement scarcely known by name. The nearly equal period before the deluge, we are apt to regard too much as a fixed point—and the recorded facts concerning it are so few, that 'the antediluvians' form, as it were, but a single idea in the mind. But it was a period of great increase of population—of large improvement in the arts—of terrible conflicts—of gigantic crimes—of extraordinary virtues—of miraculous interpositions—all of which are dimly hinted at in the divine record. Through the whole runs the longevity of the generations before the flood, which connected by so few living links the extremities of this long period of time, and which must have produced conditions of human experience so materially different from those which our brief space of existence enables us to realise."—Dr Kitto's "Daily Bible Illustrations."

The Rev. Dr Eadie, in his life of Dr Kitto, in referring to Hugh Miller's "Testimony of the Rocks," believes that that author fails to refute Dr Kitto in some points, "turning the edge of the weapon without breaking it, and is greatly inferior in cogency and conclusiveness to the positive, and very striking arguments for his (Dr Kitto's) *own hypothesis.*"

the greater amount of even human probability is in concurrence with the more obvious meaning of Scripture.

"As to that meaning, what limitation can we assign to such a phrase as this,—'All the high hills that were UNDER THE WHOLE HEAVEN were covered.' If the phrase here had been 'upon the face of the whole earth,' we should have been told that 'the whole earth' had sometimes the meaning of 'the whole land;' but, as if designedly to obviate such a limitation of meaning, we have here the largest phrase of universality which the language of man affords—'under the whole heaven.' Furthermore, if the deluge were local, what was the need of taking birds into the ark, and among them birds so widely diffused as the raven and the dove? A deluge which could overspread the regions which these birds inhabit, could hardly have been less than universal. If the deluge were local, and all the birds of these kinds in that district perished—though we should think they might have fled to uninundated regions—it would have been useless to encumber the ark with them, seeing that the birds of the same species which survived in the lands not overflowed, would speedily replenish the inundated tract as soon as the waters subsided. It is altogether a most remarkable circumstance, that the only creatures of those contained in the ark, which are *named*, are those whose existence upon earth would not have been affected by any deluge much less than universal. And if the waters of the deluge rose fifteen cubits above all the mountains of the countries which the raven and the dove inhabit, the level must have been high enough to give universality to the deluge."

The subject is a large one, and it is impossible to do justice to it within the limits of a single chapter. It is almost unnecessary to remark that our dissertation, on the question at issue, has been chiefly of a suggestive character; what has been adduced respecting the period of man's creation, has not been to insist on his contemporiety with the extinct races of mammifera, but rather to demonstrate, that his remains have been found under various circumstances, intermixed with animal exuviæ, apparently of antediluvian date. And we have somewhat elaborately referred to examples of the latter fossil discoveries, in order to exhibit the almost universal distribution of such osseous relics, both in the most recent strata, and *in the superficial deposits constituting the upper covering of the globe*—as also in limestone fissures and caverns; mainly with the object of vindicating or exemplifying the very explicit and definitive declarations of the Sacred Record, as regards the *universality* of the deluge.

What can, for instance, be more conclusive in meaning, of the destruction of the *earth* and *all its inhabitants, than* the following texts? "I will destroy them with the *earth*."—"And, behold I, even I, do bring a flood of waters upon the earth, to destroy all flesh, wherein is the breath of life, from under heaven; *and every thing that is in the earth shall die.*"—"And *every living substance that I have made* will I destroy from off the earth."—"And *all flesh died that moved upon the earth*, both of fowl, and of cattle, and of beast, and of every creeping thing that creepeth upon the earth, and every man."—"All in whose nostrils was the breath of life, of all that was in the dry land, died."—"And Noah only remained *alive*, and they that were with him in the ark."—"Neither will I again smite any more *every thing living*, AS I HAVE DONE."—"And I will remember my covenant, which is between me and you, and *every living creature of all flesh;* and the waters shall no more become *a flood to destroy all flesh.*" *

Our Saviour himself thus solemnly refers to this overwhelming catastrophe:—"In the days that were before the flood, they were eating and drinking, marrying and giving in marriage, until the day that Noah entered into the ark, and—UNTIL THE FLOOD CAME, and TOOK THEM ALL AWAY." †

We are aware that the advocates of the geologic doctrines on this point, are slow to admit such views; but we would remind them that some of their own most cherished positions on this subject are far from invulnerable, if, indeed, at all tenable. The extraordinary assemblages, of the remains of cavern animals of very varied species, and often of most diverse natures, are of themselves most inexplicable phenomena, and of which, no theory as yet broached, has afforded any satisfactory solution. The similar collections of osseous relics, which, especially of late years, have been discovered in some of the adventitious beds of clay, gravel, &c., present enigmas equally puzzling, as well as irreconcilable with the generally received geologic explications respecting them.

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* Gen. vi. 13, 17; vii. 4, 21, 22, 23; viii. 22; ix. 15.

† Matt. xxiv. 38, 39.

The discoveries of this character, which we have adduced, as having lately been made in a very circumscribed locality in Greece, and those found within a still more limited area at the foot of the Pyrenees, are little or no less difficult of explanation than are the fossil relics, of the remarkable diversity of animals, so generally found in the ossiferous caverns. As these peculiar circumstances of the several phenomena are so singularly analogous and characteristic, in the great majority of them, it would seem to indicate, that the animals *so found*, were overwhelmed by one and the same catastrophe of universal destruction; that impelled by some panic imbuing all alike with utter dismay and confusion, they fled in one desperate life and death struggle before the conspiring elements; as for instance, when lightnings were abroad, and furious storms darkened the heavens; when the aerial and embowelled thunders rolled and boomed in deafening peals around, and the earth beneath them quaked violently, when hills arose, and rocks were rent, and valleys descended, and the rocking flood-tides of the troubled ocean burst upon the convulsed and desolated land—all of which dread phenomena, we may readily suppose, were the natural concomitants of a vast revolutionizing or rather *earth-destroying* catastrophe.*

And, into whatsoever apparent asylum these multifarious tribes, might thus have instinctively dashed for common safety, or whatsoever rocky cleft or abyss, might perchance have intercepted their maddened career, and proved their destruction, as has sometimes happened to the mixed herds of affrighted animals fleeing before the devouring flames of the blazing Prairie, all such spots,—where doubtless numbers of the animals, under such appalling circumstances, must have perished from the effects of wounds or suffocation—would, in every probability, appear to future generations, as the receptacles, as it were, of whole hecatombs of carcases.

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* The "sweet Psalmist of Israel" must have alluded to some such awful visitation, where he exclaims :—"The waters saw thee, O God, the waters saw thee; they were afraid: the depths also were troubled. The clouds poured out water: the skies sent out a sound: thine arrows also went abroad. The voice of thy thunder was in the heaven: the lightnings lightened the world: the earth trembled and *shook.*"—*Psalm* lxxvii. 16, 17, 18.

In some instances, the heterogeneous relics of animals, perhaps, for the most part, previously destroyed, might have been drifted by the waters from a distance, and in all probability, deposited in accumulated masses, in various localities as now found, by the eddying currents of the ocean.

It may, perhaps, be unnecessary to intimate that, in bringing to a close our cursory observations touching the latter periods of the earth's physical history, they have throughout been but in accordance with the postulate, that "in a philosophical study of the revolutions of the globe the tertiary era of geology cannot be properly separated from the existing system of nature."

We trust it has been rendered sufficiently apparent that the actual evidence, and eminent testimony, we have been enabled to bring to bear on the soul-stirring and great subject we have had mainly under consideration, is, on the whole, highly corroborative of the scriptural record of an universal deluge; future discoveries will, no doubt, cast more light upon it—a light which, we need not fear, will but serve to reflect an increased brilliancy on the real meaning and truth of the sacred text, for whatever has been written by the Divine inspiration, cannot be inconsistent with any thing created by the Divine hand. God is truth; and his word cannot be refuted by his works. Meanwhile it behoves us, *like the* Jews of old, who preserved with most scrupulous exactitude every word of Scripture intact, and even numbered the very letters, also to watch over with like jealous solicitude, the precious statements of the Sacred Record,—our *charter and title to life and immortality.*

Far be it from us to desire to promulgate any impression, that geology, as a science, militates against the cause of religion; on the contrary, we readily concede, that its conclusions have lent a new evidence to the cause of Revelation, and have disarmed the sceptic, whilst its beautiful and abounding demonstrations, unquestionably do "confirm the Scriptural doctrine concerning man and supply proofs, that man is among the newest productions of the Creator's power, and that our kind had no existence before Adam." And though, in the progress of its astounding and instructive revelations, some startling difficulties have manifested themselves, we may rest assured, that, truth ever being consistent with itself, no real discrepancies can exist, between the Sacred Record, as rightly interpreted, and the developments of legitimate Science.

CHAPTER IX.

GEOGRAPHICAL EXTENT AND BOUNDARIES OF THE GREAT NORTHERN GREYWACKE SLATE ZONE—CHARACTER AND EXTENT OF THE GRANITIC RANGES OF THE MOURNE MOUNTAINS—METALLIFEROUS LODES—WHIN DYKES—DILUVIAL DETRITUS—ENUMERATION OF COPPER, LEAD, AND OTHER MINES—GYPSUM MINES OF DOWNSHIRE—ALSO OF MONAGHAN—MINERALS OF CAVAN—BOULDERS—DILUVIAL ACTION—GRANITE BLOCKS NEAR GENEVA, IN SAVOY, AND THE VALAISE, &C.—GLACIERS AND ICEBERGS—CONFIGURATION OF THE SURFACE OF CLAY-SLATE TRACT—NEWRY—ROSSTREVOR—SOIL OF SLATE TRACTS—CULTIVATION IN MONAGHAN, &C.—IMPORTANCE OF PLANTING AND DRAINING—LORD CLARENDON ON THE RURAL ASPECT, CHARACTER, &C., OF THE LOUGH NEAGH DISTRICTS.

THE great northern clay-slate, or greywacke, district of Ireland constitutes—with the exception of the granitic Mourne Mountains—the whole coast line extending from Belfast Lough to the estuary of the Boyne, ranges far inland, and forms a vast triangular region comprising the counties of Down, Louth, the southern halves of Cavan and of Armagh, the greater part of Monaghan, and portions of Longford and Leitrim. The southern border is marked by its junction with the lower and calp limestone, forming a tolerably direct line from Drogheda to near Longford; and a line drawn from Donaghadee past Armagh and

Monaghan to the western slopes of the sandstone hills opposite to Carrick-on-Shannon, would describe its northern limits, where, in a line with the Ulster Canal, it immerges beneath the lower and middle carboniferous limestone of Monaghan and Clones. Some isolated patches of granite and other rocks occur in Cavan and Louth, but the Newry range of granite, —which, with trap rocks and greywacke, forms the picturesque borders of the Bay of Carlingford—constitutes a large and important district; commencing in Down, and passing into Armagh, it extends twenty-eight miles in length by twelve in breadth. It presents evidence of great disturbance. The Newry granites belong to the "soda granite" type, and in many respects are very similar to the secondary granites of Wicklow and Wexford. The granite in the neighbourhood of Carlingford, is a potash-granite, in which hornblende replaces mica. Altered (metamorphic) rocks, including gneiss, serpentine, greenstone, micaceous slate, and flint slate, constitute (with clay-slate), all the portions of the Mourne Mountains not occupied by granite, and also form a broad skirt round three of the exterior sides of the granitic district, in which is situated the town of Newry.

Some copper lodes have been discovered in their vicinity, but the large area we have just described as being occupied by the adjacent Cumbrian or lower clay-slate system,—mainly consisting of green and purple slate, interstratified with coarse-grained crystalline bands—may correctly enough be denominated the great lead-bearing district. Nearly throughout, in various localities, it is known to be traversed by a great number of capacious, well-defined, and often very productive metalliferous lodes. They are subject to be occasionally intersected by broad whin dykes, bands of trap or porphyritic rocks, not unfrequently forming the wall of a lode, or at the distance of a few feet running parallel with it, a circumstance which is considered generally to exert a favourable influence on the ore-bearing qualities of the vein; the *impermiable* nature of the porphyritic channels, being conducive to the accumulation of rich deposits of mineral, as so commonly observable in the occurrence of cross courses. At all events, experience teaches, that where the bounding rocks are characterised by an uniformity of chemical and mechanical structure, the ore is deposited in less important quantities, than where dissimilar formations effect a junction, or closely approximate to each other, and also where numerous veins, and lodes, meet or intersect one another. Such local conditions, perhaps, mainly induce the occurrence, though capricious distribution, of metallic deposits.

In County Monaghan, and other large areas of the extensive greywacke region we have under consideration, *vast* accumulations of diluvial drift occur, in which is embedded innumerable fragments of granite, limestone, porphyry, quartz, slate, &c., derived from the circumambient formations; it contributes largely to that diversified conformation of the surface, here so strikingly manifested in a continued series of low undulating hills and valleys; but whilst it imparts both beauty and fertility to the country, it militates greatly against the discovery of the numerous lodes which undoubtedly traverse the great sub-formations. They are, however, not unfrequently met with in cutting ditches, water-courses, &c.; and at the present period a considerable number of valuable mines are in operation, nearly the whole of which are situated in localities intersected by whin dykes. In Armagh there are seven mines of lead and one of copper; Cavan, one of lead and one of iron; Louth, two of lead and copper; and in Down and Monaghan some fifteen of lead, two of antimony, and three of copper, one of the latter being in the Mourne Mountains.

In Downshire thick beds of gypsum occur near Carrickmacross, lead and manganese is found near Warrens Point; copper ore, about five miles north-east of Rosstrevor, near the junction of the greywacke slate with the granite; copper has also been discovered, under very similar geological conditions, about three miles north of Newry, and in some other places about the Mourne Mountains. Lodes of argentiferous lead and copper occur in the clay slate near Strangford. Indications of the latter between Bangor and Newtown Ards. Some promising lead lodes have been opened upon in the slate ranges north of Dundrum Bay, at Ballylady, and near Killough. A valuable lead mine is in operation near Newtown Ards, which, in 1853, yielded 1606 tons of lead ore. In these undulating districts around the Mourne Mountains, considerable facilities are afforded for working the mines by levels, and water power is almost always to be readily obtained.

Some curious examples of granite veins in greenstone-porphyry occur near Carlingford, and are well worth the attention of the geologist. "At the junction of this granite with the carboniferous limestone of the neighbourhood, a remarkable change takes place in the granite, on penetrating the limestone in dykes. From being originally a compound of quartz, orthoclase, and hornblende, it is converted by the addition of lime into a compound of hornblende and anorthite, which latter mineral was noticed for the first time as entering into the composition of British rocks."

Towards the sea, on the north-east and east parts of Down, there are several slate quarries in operation.

Many large and well-defined lead lodes intersect the clay-slate districts in the neighbourhood of Castleblaney, *they commonly* maintain a nearly north and south bearing, and some of them have proved very productive, the principal courses of ore being generally met with at or near the intersections of the veins, or where they happen to come in contact with any of the numerous cross-courses or porphyritic channels which here traverse the country. The Tassan lead mine has yielded very considerable quantities of ore, and the works are being vigourously prosecuted under encouraging auspices. Coolartragh lead mine, in the vicinity of the above, during a long period made large returns, and the neighbouring mine of Anaglough produced, in 1852, above £5000 worth of silver-lead ore. The other Contibret mines are Lisglassan and Tullybuck, consisting of antimony, and Carrickaderry of lead. There are four lead mines near Ballybay, and one of lead and zinc near Ballanode.

The Cumbrian, slate tracts of Monaghan, and the adjoining county of Cavan, present indeed, a very encouraging field for the labours of the miner, and mineral explorer, although from the generally unbroken character of the country, and the frequent occurrence, as above intimated of vast adventitious beds of marl, clay, and gravelly debris, the mineral lodes, are much concealed from observation, but they may not unfrequently be detected, in the beds of rivulets, ravines, or by the rude and partial openings formerly made on the backs of the veins, and which from the character of the matrix, &c., that has been thrown out, often present very satisfactory indications, of their ore-bearing qualities.

Between Cootehill and Cavan, lead and copper mines are met with, and lead ore, has been discovered near Ballyconnel, in the upper carboniferous limestone, forming a narrow belt, to a patch of the millstone-girt, which is largely developed in the adjacent coal fields of Leitrim. Coal and iron mines are being wrought at Swanlinbar, and Quilca, in the Ballynageerah range of mountains. Some beds of Fullers earth, potters-clay, and marl, are abundant, and coarse manganese, and ochre, are occasionally obtained. The handsome mottled marbles of Armagh, are quarried from the beds of lower carboniferous limestone, and which from thence, in the direction of Monaghan, and Clones, rest upon the northern skirts of the greywacke slate series. The mountain group which occurs in the N.E. part of the county, consisting chiefly of granite, is a continuation of the Mourne Mountains. Its other divisions are occupied mainly by a series of low hills and valleys of considerable fertility, but the sub-letting system, so prevalent in this part of the country, has proved greatly detrimental to a higher state of cultivation, and resulted in very general poverty.

We have briefly adverted to the enormous superficial deposits, which are so generally spread over the slate tracts of Monaghan, and neighbouring districts, and *we would here* say a few words on the boulders and fragments of rocks they contain, and which are so prevalent in the central and northern parts of Ireland. Such phenomena, and the often deeply furrowed deposits of clay, gravel, &c., alike strikingly denote the force and prolonged power of the agencies which have so modified the face of the country, since the upper tertiary beds were formed. These, in all probability, were the oceanic currents, which would appear to have swept over the Island, generally in a S.W. and N.E. direction. They have occasionally denuded extensive formations of their upper strata, or carried away whole deposits, piling up their disrupted materials in far off localities, as we now find them. Even the very large granitic boulders, and other massive fragments, of crystalline rocks enclosed in these adventitious accumulations, obviously owe their distant transit to such aqueous causes, though there are numerous existing examples of erratic blocks in this and many other countries, to which no such ordinary mode of transport can be reasonably ascribed.

Such for instance, as the enormous masses of granite scattered over the calcareous mountains in the vicinity of Geneva, and in the valleys of Savoy, to the distance of upwards of sixty miles, from the parent rocks, some of which, have even traversed the Jura, into France, a distance of 100 miles. Mr Bakewell, in allusion to the former remarks that, on the southern *slopes of the* valley of the Arve, may be seen the magnificent ruins, of mighty mountains, and the monuments of an overwhelming catastrophe, which transported these ruins into their present situation. The snow clad mountains from which they were torn rise magnificently to the view, though fifty miles distant. On the little Saleve, at the height of fourteen hundred feet above the valley, are scattered numerous blocks of granite of vast size, not at all water-worn, and almost as fresh as if recently torn from their parent mountains, they are of that kind of granite called Protogine, in which talc, or chlorite, is one of the component parts, and are identical with the granite, of Mont Blanc, while the Saleve on which they lie, and the surrounding mountains are calcareous. Saussure, supposes the rocks were torn off during some sub-marine convulsion of nature, and transported by a sudden rush of waters. It is observed that many of the blocks rest upon deep beds of water-worn debris.

In the Valais, or valley of the Rhone, (which is above ten-thousand feet deep, sixty miles in length, and varies from a quarter of a mile to three miles in breadth) we have observed, on our way up it to the pass of the Simplon, some prodigious masses of granite, and schistose rock, completely isolated, and often at great distances from their parent formations. It is not, however, difficult to suppose that these blocks *may have been transported* by the transient floods of the Rhone, for it is evident such masses are much more easily moved in water than on land, in consequence of the law in hydrostatics, that a solid body fully immersed in water weighs so much less than it does in air, by a sum equal to the weight of the mass of water which it displaces. The torrents from the south-western Alps, rushing over a comparatively uninterrupted slope, have transported large boulders of rock to the Mediterranean.

The several hypotheses, above adverted to, would however appear to be inadequate to account for phenomena, of the more remarkable character. The glacier, or iceberg, is conceived, with much probability, to have transported many of these enormous blocks to distant localities; the latter, where cradled in rocky regions, would naturally become gradually freighted with innumerable stony fragments; and dissolving, often on distant seas, they offer perhaps the most satisfactory explanation, that has yet been advanced on the subject; nevertheless, they are in our estimation, quiet insufficient to account for certain appearances of this kind, which occasionally present themselves in our own and other countries. For example, we find in the basaltic districts of Antrim, greenstone blocks, some of fifteen or twenty feet, or more, in circumference, scattered about in valleys, on the slopes and ridges of mountains, and in every conceivably *odd* situation; but, as we proceed from the confines of the basaltic area, say towards the west, we presently perceive that the greenstone blocks, become less apparent, and soon almost entirely disappear, but on reaching the vicinage of the granitic ranges of Donegal, granite boulders occur, and increase in numbers as they approach the parent rocks. These facts certainly point to the operation of more local causes to account for so singularly partial a dissemination of the disrupted fragments of the respective formations. In fact, so far from being *erratic* blocks, they evince a peculiarly *stay-at-home* disposition, and love for the parent bed; and as to the iceberg, it assuredly would have made a much more promiscuous distribution, of such stoney favours, over the whole face of the country.

The great triangular area of greywacke slate,—the metalliferous contents of which we have been investigating,—presents a very varied contour of surface, but, contrary to its usual topographical characteristic, of sharp angular elevated chains or ranges, it assumes a very general aspect of interspersed hills and rounded elongated eminences; the Slieve Croob, and the Mourne Mountains constituting the boldest features of the landscape, in this part of Ireland, and the highest of which, Slieve-Donard, composed of granite and greenstone, attains an elevation of 2793 feet.

Many of the valleys skirting these ranges are characterised *by much fertility* and rival beauty. The agreeable and important town of Newry, lies snugly ensconced in the bosom of one of these picturesque vales, and which, increases in romantic interest as it approaches Carlingford Lough. The sequestered watering-place, Rosstrevor, is delightfully situated at the extremity of a small cove of the bay, and at the foot of a mountain 2000 feet in height. Attracted by the peculiar amenities of the spot, many of the gentry have taken up their residence here, and it is greatly resorted to by invalids, being completely screened from the north by its mountainous amphitheatre, and open on the south to mild and salubrious breezes which reach it across the placid waters of the land-locked mountain-fringed bay of Carlingford.

The soil of the slate tracts in the more elevated situations is commonly of a thin hungry character, being for the most part merely constituted of the components of the rock—alumina, felspar, and chlorite, sparingly diffused; but the greater portions of the range, especially as it trends inland through Armagh, Monaghan, and Cavan, being covered thickly over with rounded elevations of adventitious materials, such as marl, or the productive admixture of clay, sand, and lime, the soil is of a varied and not unfrequently very fertile quality. The mountain limestone which skirts the slate to the north, constitutes a bleak and not very productive range, but the valleys and lower grounds near the junction of the respective formations, commonly comprise very fine tracts of loamy arable land, as is particularly the case in the several vicinities of Armagh, Monaghan, and Clones. The grass fields in the neighbourhood of the two former especially present a luxurious appearance; and an improved system of cultivation prevails over some of the extensive tillage tracts of this part of Ireland.

A patch of New-red-sandstone traverses the southern part of Monaghan, extending to Kingscourt in the county of Cavan. The lands of this formation, and the adjacent tracts of carboniferous limestone, present a smiling and fertile aspect, and where any approach to good husbandry is practised, some very abundant crops are produced. This is also very apparent in the central districts, comprehending the baronies of Monaghan, Cremorne, and Dartree or Dartry. The more extensive estates of this part of the island, belong chiefly to absentees, and amongst the dense population of the country poverty and improvidence are very characteristic features. Lime is much used as manure in the clay-slate districts, and in the lower localities where the aspect and drainage is pretty good, very fine crops of oats are produced; a crop which is here generally repeated two or three seasons after wheat or potatoes; considerable breadths of flax are also grown here.

The superabundance of alumina, or clay, in these slate regions produces, on the whole, a cold retentive soil, which is best improved by thorough drainage, and the application of almost any material that may tend to give it a more open texture, as burnt clay, sand, &c. The general appearance of much of the country is elevated, open, and bleak, wood being much required for the protection of the cattle and crops, as well as the adornment of the landscape. A judicious system of planting and perfect drainage, with the excellent cultivation which we have observed on some farms held by Scotchmen, a few miles east of Armagh, could scarcely fail to double the value of these lands in a very short period of time. We may here observe, that as a general rule, it is affirmed, land now selling in England at thirty years' purchase, may be bought in Ireland at from fifteen to twenty; and almost all far more capable, and at a much less expensive outlay than any in the former country.

The country north of Armagh, commencing with the New-red-sandstone tracts, and extending through the fertile districts round Lough Neagh, on the verge of the extensive basaltic region of Antrim, has a very verdant and often richly productive appearance; but many of the mountainous parts of Antrim are covered with peat-bog and moor, though most of the slopes and valleys afford excellent sheep pasturage. We cannot, however, do better than quote here the description Lord Clarendon gives of this flax-growing *country*. Of the districts bordering Lough Neagh, his Lordship says:—"The fields in the neighbourhood are generally small, but admirably tilled; one, an acre in extent, was pointed out to me, on which £40 worth of oats was grown last year, by a small shopkeeper in Caledon. Hear this, ye English philosophers, who talk of small farms being the ruin of Ireland! I am quite persuaded, that it is not to small farms, but to sub-letting, that the agrarian misery of Ireland is owing; the small holdings in this country are models of agricultural industry and prosperity. On our return we rode through Lord Caledon's park, watered by the Blackwater; and I must express here again my astonishment at the 'greenth' of this part of Ireland. It is not uncommon for a meadow to be fed off till June, mown in September, and then fed off again; or to be mown in July, fed off in August, and then mown a second time in the autumn."

Proceeding further to the north, His Excellency continues his descriptive remarks:—"The road, as far, at any rate, as Garvagh, is very interesting. Slieve Gullion, and other mountains, form a noble background to a landscape, radiant and rich with green meadows, purple bogs, upland farms nestled among orchards, and spruce little towns, such as Crookstown and Moneymore. This is the kingdom of the companies, and a well-ordered kingdom it is; you rub your eyes as visions of trim hedge-rows, painted wooden *gates, stone farm*-houses, with gay gardens in front, well-built, well-drained streets, spacious town-halls, picturesque school-houses, &c., flit before you. Of these corporations, it cannot be said they have no souls; stomachs all the world allows them to possess. The 'amari aliquid,' which disflavours this fountain of contentment, is the non-individuality of such excellent landlords. 'That a neighbour,' said a gentleman of the north of England to me one day, speaking of the forfeited Derwentwater estates, 'who can't give one a bed and a bottle of claret;'—but for all tenants, tradesmen, peasants who sit under them, there is no room to doubt these great London companies are excellent landlords. Coleraine, the capital of this Cockney kingdom, is prettily situated on the Bann, the banks of which above the town are well wooded. It was dark long before I reached Coleraine, and the view out of my window, up and down the stream, broke upon me with a pleasant surprise. Go where you will in Ireland, you are sure to find hospitality and kindness, and so I found myself next day established under a most pleasant roof near Port Stuart, a neat modern little bathing-place, the Kildee of the north; much of the land round it, close to the sea-shore, has quite recently been brought into cultivation; one tract was pointed out now dotted with farm-buildings, corn-stacks, &c., which only three years ago was a desolate abode of conies."

CHAPTER X.

Laws and Phenomena affecting Metalliferous Deposits—Evidences of Design and Order—Natural Guides, or Indications—Metalliferous Channels—Metallic Nature of Earths — Barren Strata — Rocks Charged with Metallic Salts — Aggregations of Ore — Magnetism — Meridional Action—Lodes of Fracture—Impermiable Rocks—An Existing, but, as yet, Hidden "System"—Diversity—Singular Changes—Crystallization—Distinctive Character of Minerals in Different Districts—Important, Practical Knowledge—Law of Polarity—Comprehensive Views Indispensable—Importance of a Due Registration of all New Facts and Discoveries.

An examination into the mineral capabilities of Ireland, forming, perhaps, the more prominent theme of our present inquiries into her material resources, and seeing how abundantly stored she is in these grand elements of progress, success, and power, and of what paramount importance to her regeneration and future welfare, is their extensive and successful development, we are induced to offer here a few such observations on the laws and phenomena affecting the distribution of metalliferous deposits, as we trust may prove acceptable not only to the uninitiated explorer, and Tyro in geology, but to the generality of our readers.

The *philosopher,* who studies the multifarious objects which, every where, adorn the fair face of nature, is inevitably led to the conclusion, that they owe their mysterious and perfect development to certain definite, immutable laws. So palpable, indeed, is the general impress of this truth, that the observant mind, however unlettered, can scarcely fail to recognise it. The poor miner, even, whose lonely avocations are carried on amid the secret recesses of the earth, has his attention frequently drawn to startling manifestations of cause and effect, beauty, utility, and perfection. And as these natural attributes present themselves to his notice, how eminently calculated are they to excite his curiosity, stimulate his reasoning faculties, and irresistibly lead him to shrewd conceptions, or perhaps conclusions, that, where apparent confusion reigned around, all is, in reality, design and order, abounding in wisdom and benificence, and presenting the most unmistakable evidences of prospective regard, for the requirements, and the welfare of mankind.

A vivid and lively consciousness of these grand truths, naturally begets a praiseworthy spirit of inquiry, and the awakened mind eagerly endeavours to discover, and define, the secret processes of the fundamental laws, which—though by silent and insensible action—are continually producing, around, above, beneath us, the most marvellous and magnificent results. Our present knowledge of the acting principles of such of *them*, as pervade the geognostic and mineralogical world, although necessarily so vague and imperfect, is eminently calculated to afford important assistance to the practical miner. The mine captains of Cornwall particularly, and who, as a body, are conspicuous for their habits of acute observation and their intelligence, have already learned to appreciate the importance of these natural guides, and not unfrequently avail themselves of them, with the happiest effects. The existence, for instance, of "metalliferous channels" of ground, and of the magnetic currents which permeate them, are, perhaps, among the most prominent of the natural phenomena, which their varied and constant experience has induced them to value and entertain as received doctrines.

To the *eye*, however, the positive presence and width of these metalliferous channels is, of course, best to be determined by their ascertained *effects*, as manifested by the parallel bunches of ore in a series of east and west lodes, intersecting at right angles the said metalliferous run or channel of rock. Rare, indeed, must be the case, where the presence of the metallic matter itself would form so visible a component of the rock, as to determine, at sight, its true metalliferous character.

It is now ascertained, that the very earths of which rocks are composed, are of a metallic nature, and therefore, a given rock, or even formation, may, without the *visible exhibition* of one single metallic molecule, be nevertheless rich in the elementary principles which constitute the formation of the metallic ores. The fact, however, is unquestionable, that some rocks are barren or non-metalliferous; whilst others, and even some strata of the same rock, are rich in metallic matter, and hence (usually from their proved *effects*) called by the miners, *bearing measures*. Even the quality of the ore often varies with that of the rock through which it passes,—an additional proof that lodes owe their metallic contents to the bounding rocks, and that such ores were neither poured in from above, nor eliminated from below.

As touching this interesting question, an eminent, but in relation to geological science, an early authority, suggests that metallic matter was diffused through different rocks, according to their elective affinity, and separated from them by voltaic electricity; or the strata may act like a series of plates in the voltaic pile, separating and secreting metallic matter from its different combinations. Whatever may, in reality, be the natural processes which generate and distribute the mineral masses in the great laboratory of the earth, actual observation, experiment, and the deductions of science, have alike very satisfactorily demonstrated that magnetism is *there*—a grand, transposing, ever-acting, all-pervading principle.

Its provident, and mighty-modifying effects are most apparent in the economic and mechanical structure of the primary base, or great framework of the globe. The universal laminary structure of the slatiform rocks, as exhibited in their vertical laminæ, running in a north and south direction, is one of the most palpable examples, of the meridional action, and transposing powers of the ever-circulating magnetic currents; and, as both experiment and natural evidence, warrant the belief that the metallic solutions of the bounding rocks are deposited in the "lodes of fracture," by the action of this subtle agent, in its course from south to north, and as it is known that the intervention of the slightest non-conducting substance, in the cleavage planes, is sufficient to turn the course of the magnetic current, it must appear obvious, that a lode intersecting the laminæ in question, at right or oblique angles, is a geognostic condition highly favourable to the local accumulation of minerals; tantamount, perhaps, to the importance now commonly accorded to the angular position of lodes.

The practical explorer has, in short, in this general principle, a clue to these secret workings of Nature—a grand natural auxiliary, which, when assiduously and skilfully consulted, will tend ever to open up new fields of discovery, and lead to accumulated advantages, of the first importance to mining enterprise. *Its genial* and productive effects are often especially manifested, in its relations to such local conditions, as the juncture of primary masses and porphyritic bands, with killas, limestone, &c.; the intersections of cross-courses, occurrences of flookans, angular lodes, and moist *impermiable* rocks, presenting thus much convincing evidence of the latent combined causes, which influence the distribution of metallic deposits, and in a measure dispelling the great uncertainty and hazard so commonly attributed to mining operations.

It cannot, however, be denied that both the practical miner and scientific investigator, in the course of their actual labours, not unfrequently encounter such strange freaks of nature, and startling anomalisms, as to shake their confidence in the most admissable and cherished code of rules, and seemingly to set at defiance every effort of man to reduce the art of geognostic investigation, and mining, to a certain *system*. But such local impediments, will rather tend to stimulate, than discourage, the inquirer who takes a wide and comprehensive view of the grand operations of nature, and who, in so doing, is right well assured, that he is in search of the secrets, and the *modus operandi* of a *system*, which *veritably pervades* the dark recesses of her *subterranean storehouses*, and, in all that admirable order, and perfection, which invariably distinguish the glorious works of creation.

Diversity is one of the most marked attributes of nature's operations, and we see it exhibited in endless variety, without any violation of the primary laws of nature. As regards metallic veins, they not unfrequently contain various ores at various depths; indeed, the very matrix or gangue of a vein will vary as it passes through different strata. The lodes, in which are situated the valuable copper mines of Lake Superior, afford singular exemplifications of this kind; in tracing the veins from north to south, a remarkable change is observable in the character of the contents as they enter into different formations. Beginning with the conglomerate on the Lake Shore, the main lode presents very little native copper, but is charged with the black oxide and green carbonate; passing south into the amygdaloidal trap the native copper is found most abundant; but, on then entering the crystalline trap or greenstone, the vein presents little or no copper in any shape, again penetrating into the amygdaloidal trap it appears as before, rich in cupreous contents; and in the porphyry it assumes the form of a sulphuret.

And, it is believed that certain local causes, influence the crystallisation of minerals in different districts, disposing them to take peculiar secondary forms, which may be considered as appropriate to the minerals of that district. These dispositions of nature, should ever be borne in mind by the mineral explorer, for in distant localities, or districts, he will often have occasion to notice a marked difference, in the character and appearance of what are commonly considered, as the leading or predominating indications of the existence of rich mineral deposits. What the experience of the miner has justly led him to appreciate as an infallible indication in his own particular district, may, in a distant one, be no guide at all, or none on which any real dependence could be placed. The *gossans*, for instance, are rightly esteemed by Cornish miners as first-rate indications, almost certain to lead down eventually to large and valuable deposits of ore. Indeed, they are often such predominating features in the Cornish lodes as nearly to fill them to a depth, of thirty, forty, or more fathoms. As a general rule, however (subject, of course to local modifications,) the presence of gossans, are most favourable indications, as commonly constituting the exuded hydrous oxides and sulphates of the metallic ores existing in the lower regions of the lode. Nevertheless, gossans, even in the most productive mines, in some countries, are altogether absent, or nearly so.

Perhaps, from no other area of the same dimensions, throughout the world, has so much valuable practical knowledge of the more cognitive or appreciable laws, which govern the distribution, &c., of metallic ores, been acquired, as in the little honey-*combed* peninsula just adverted to, and of which, the following observations afford some important illustrations:—"If, after a lode has been formed, it becomes dislocated, and one portion of it has its line of direction changed a few degrees by the movement of a portion of the earth's crust, by no means an unusual occurrence, the character of the mineral immediately undergoes a change. The main direction of the copper-lodes of Cornwall is from the north-east to the south-west, or nearly so; and these lodes contain, almost invariably, the yellow copper-ore. In the St Just district, northwards from the Land's End, by some great convulsion of nature, we find the ground greatly disturbed, and the mineral lodes have a direction from the south-east to the north-west; the copper ore in all these mineral veins, is the grey sulphuret, and they are very peculiarly characterised by the peroxide of iron which abounds. From these facts we learn, that the position determines, or at all events regulates, the character of the metalliferous deposits; one kind of mineral prevailing when the receiving fissure has been formed in one direction, and another when it has exhibited any deviation from that line. Phenomena of this kind appear to lead, as by a natural inference, to the conclusion, that some law of polarity has been at work; and that we know of no physical force to which we can so appropriately refer the deposition of metalliferous ore in a rock-fissure, as to electricity." *

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* Eclectic Review.

And which deduction, receives a further confirmation from the recognised feature, already adverted to, that in countries where a series of diversified rocks or stratifications occur, it impresses a peculiar character upon the contents of the veins, the metalliferous portions of which are, for the most part, confined to certain strata, while the intervening parts are poor and unproductive.

In the lead mining districts of Derbyshire, Durham, and in other parts of the north of England, chiefly where the interstratifications of carboniferous limestone prevail, examples of this character are of common occurrence. And the knowledge of such facts, are of obvious utility in facilitating mining operations.

Metalliferous veins are very commonly found to run nearly parallel, and often within a short distance from each other; they are frequently intersected at right angles by other veins or cross-courses, which rarely contain ore, except perhaps near the points of intersection; the neighbourhood of a productive vein is generally considered a favourable indication of the contents of others in the vicinity. The ore-bearing veins of distant districts vary considerably in their direction; it is, however, remarked that copper lodes have generally an easterly and westerly direction, and that lead lodes commonly run from north to south, or *nearly so.* Experience has shown that "the most favourable position of a fracture for the accumulation of minerals is at right angles to the grain of the district, and slightly dipping northward; the unfavourable fracture is that dipping southward at a flat angle under a heavy hill." The extent of metalliferous veins is unknown, as well as the depth to which they descend; in width they vary much, from the eighth of an inch to thirty feet; but they are commonly from one to three feet in thickness.

The miner, of ordinary intelligence, accustomed to delve in the mines of a particular tract of country, often exhibits a sort of instinctive knowledge of the precise matrix of the lode, and the adjacent rocks, which are, therein, the true indices of the presence of metallic riches. For example, though he cannot distinguish which of the bounding strata are so richly saturated with the metallic salts as to entitle them to the designation of "metalliferous channels," he has simply, by experience and close observation, learned to judge of their local presence by the rich deposits he finds opposite to, and corresponding with the width of such channels. He has also ascertained that parallel lodes produce parallel bunches of ore. The true character of the feeding rock being thus ascertained, he has only to mark what are its exact mineralogical appearances, &c., and compare it with the other rocks or strata as a means of discovering analogously, *other* bunches or deposits in the same or opposite lode, or in others of the neighbourhood. As a general rule, this, in a given district, may be of much practical utility, but is, nevertheless, subject to obvious exceptions.

"Metalliferous channels," are doubtless, extremely arbitrary as to their run and dimensions; a narrow course—say of ground studded with valuable mines over an extent of miles in length—may, in a general sense, correctly enough, be denominated a "metalliferous channel," but nevertheless it would be subject to be interspersed with innumerable barren channels, and, as is often tested, by the occurrence also of many a poor mine. Hence, notwithstanding our absolute knowledge of directing and encouraging phenomena, we are ever and anon reminded of its present limits, and of the necessity of proceeding, in our practical labours, with all due caution and circumspection.

We have intimated that extended and comprehensive views, of the natural phenomena, bearing upon practical mining, are indispensable to a just and competent judgment of the same, and their successful application to actual, general explorations, and scientific investigations, and we may reasonably hope that such desiderata, will be pretty effectively supplied by the inquiring and persevering spirit, which now everywhere animates the mining world; a careful comparison and collation of natural facts, and discoveries, *derived thus* from *different*, and distant localities cannot fail to furnish new data, of the utmost import, towards rendering clear and intelligible, much that is now proverbial for its puzzling and inexplicable character. But however startling, may be, the anomalies and sportive vagaries of nature, which we may happen to meet with in the course of our actual investigations, of this, we may rest assured, that notwithstanding any such apparent confusion and disorder, she is the parent of harmony, order, and economy; and be her handywork whatsoever it may, it will invariably be found to bear, everywhere, the deep impress of those glorious attributes. As in

> "The moral world,
> Which, though to us it seems embroil'd, moves on
> In higher order; fitted, and impell'd,
> By wisdom's finest hand, and issuing all
> In general good."

CHAPTER XI.

COMMERCIAL AND AGRICULTURAL VALUE OF PEAT TURF—EXTENT AND SITUATION OF IRISH BOGS—FORMATION OF PEAT—QUALITY—EARLY USE—PEAT PATENTS—ANALYSIS OF DO.—VARIED USES—CARBONIZATION OF PEAT—SUPERIORITY FOR STEAM—FOR IRON MANUFACTURE—AS A FERTILIZER AND DEODOURIZER—OIL AND OTHER PRODUCTS—COMPARATIVE VALUE OF PEAT AND COAL—ITS CAPABILITIES FOR AGRICULTURAL PURPOSES—RECLAMATION OF PEAT-BOGS—SCIENCE AND ENTERPRISE, THEIR RESULTS INVALUABLE.

THE Peat Bogs, of Ireland are become too important a feature in her domestic economy, not to occupy a place of some prominence in our cursory review of her industrial resources. They are become especially valuable in a commercial point of view; and for agricultural purposes, it is well known, their burnt, or prepared, decayed vegetable matter furnishes a most fertilizing manure.

It is estimated, that the Irish turf bogs occupy a total area of 2,830,000 acres, and vary in thickness from twelve to forty feet. Of this quantity, the great proportion of flat or red bogs, irregularly, constitute rather a broad zone of country, extending from King's County and County Kildare—adjacent to Dublin *County*—across the great limestone plain, to the coasts of Connemara, Mayo, and Sligo; this great system of bogs is divided into two parts by the River Shannon, most of those which lie to the eastward constitute the extensive tract generally known by the name of the Bog of Allen. The Great Southern and Western Railway, and the Grand Canal, from Dublin to Shannon Harbour, pass through an extensive division of the bog district. The remainder, or mountain bogs, are disseminated over the elevated districts, chiefly near the sea.

Dr Macculloch has enumerated nearly forty plants which concur to the generation of peat, beside the Sphagnum palustre—a plant which very distinctly exhibits the process by which the vegetables are converted into peat. As the lower portion of the plant dies, the upper is annually renovated—thus continually preserving its existence, and not unfrequently causing a yearly growth of peat-bog, of from one foot to two feet a year. On the conversion of vegetable matter into peat, Dr Macculloch observes:—"Where the living plant is still in contact with peat, the roots of the rushes, and ligneous vegetables, are found vacillating between life and death, in a spongy, half-decomposed mass. Lower down, the pulverized carbonaceous matter is seen mixed with similar fibres, still resisting decomposition. These gradually disappear, and at length a finely powdered substance alone *is found, the* process being completed by the total destruction of all organised bodies. The quality of peat is much affected by the wetness or dryness of the soil, and the elevation, or other causes, which influence the temperature and moisture of the atmosphere."

Peat commonly contains salts of lime and iron in its composition, but rarely in such quantities as to detract from its superior qualities as a smelting agent. The best peat is considered to be that of which the decomposition is most complete, and the specific gravity and compactness the greatest. Its conservative properties are well known, and the peat turf tracts of Ireland, are even believed to communicate salubrious effects to the atmosphere of their respective vicinities.

Peat appears to have been employed as fuel as early as the commencement of the sixteenth century; and in 1560 was used in Saxony for metallurgical purposes. Within the last few years, a variety of patents have been taken out for the treatment of peat, and its application in the smelting of metallic ores; some of which are producing highly satisfactory results. Messrs Gwynne and Co.'s invention, consists in the production of a fuel from dried pulverized, and subsequently compressed peat, and by which process, it becomes so solidified, as to possess a specific gravity greater than some coal. The superiority of peat, either in this dried compressed state, or as charcoal, has been very satisfactorily demonstrated by Davy, Fredgold, Letheby, and other eminent authorities.

As some doubts, however, may be entertained on this highly important and interesting subject, we may here give an extract or two from the Report of Dr Letheby to Messrs Gwynne & Co., and by which, it will be seen, that the results, as to any existing earthy matter in the peat, are very satisfactory. The Doctor says:—"The specific gravity of the sample of compressed peat which you sent me here on the first instant, was as high as 1.140, and its structure was exceedingly hard and dense. The actual stowage weight of one cubic foot of the material was 71.24 lbs. avoirdupois, that of Newcastle coal being about 49.69 lbs.

"The charcoal contained 3.8 of ash; 7000 grains of the peat were submitted to distillation in an iron retort, and the volatile products were conducted through a red-hot iron tube, in the hope that the paraffine, &c., of the tar would be decomposed, and converted into a gaseous hydro-carbon of high illuminating power; the results were—2520 grains of charcoal, 1320 of ammoniacal liquor, 360 of thick tar, and 2800 of combustible gas. *The gas was found to be entirely free from sulphur*, and in this respect it has great advantages over coal gas. *The ashes which remain never aggregate*, so as to form a clinker, and *consequently there is* little or no attention required to keep the bars of the furnace clear for the draught. The peat is admirably well suited for domestic purposes, and also for furnace operations in large towns, where, at the present time, the enormous quantity of sulphur evolved from coal during its combustion, is a source of annoyance and injury to life and property; it burns quickly, and therefore produces steam in a short time; it possesses tolerably high evaporative power; it is not bituminous, and consequently does not evolve opaque smoke while burning; it is not likely to be broken by attrition; it is entirely free from sulphurets; and is not liable to spontaneous combustion."

As although the ashes are stated at 3.8, we are aware that some specimens contain only one per cent, while others that are mixed with clay may contain thirty; but no one that knew anything of iron making would use the peat that contains more than five or six per cent; but hundreds of thousands of acres can be had with three or four per cent of ash. Frederick Overman, no mean authority respecting iron and steel manufacture, says:—"It has been found that turf or peat is a most excellent fuel for the blacksmith's forge, in case-hardening steel, forging horse-shoes, and particularly in welding gun-barrels, &c., where its composition is shown to be favourable by chemical analysis. We need not be harassed in relation to its price, (he *says), for its utility* is so obvious that a liberal expenditure may be safely hazarded. In Styria, sheet-iron and re-heating furnaces are heated by it; and in Bohemia, Bavaria, France, and Prussia, it is extensively used in the blast furnaces, and produces, in most cases, very liquid, lively iron. Good turf coal is superior to charcoal in the blacksmith's fire."

In the Great Exhibition of 1851, there was a bound volume, the leaves of which were of iron, and as thin as ordinary book paper. This iron was manufactured in Germany (by a very crude imperfect method) from peat charcoal.

The great superiority of the Swedish and Russian iron to that of the English, is said to be caused by the circumstance, that wood, or "vegetable fuel," is used in its manufacture instead of "mineral fuel." And hence, even in England, common cut turf is often mixed in the coal when iron of a superior quality is to be made.

A new mode of compressing peat, and its applicability to industrial purposes, is now being propounded by Mr Hays; his avowed object being to procure at a cheap rate from peat the four principal products,—charcoal, tar, gas, and ammoniacal liquor. The chief merit of his plan appears to be the saving of tar and gas by a very inexpensive process; the latter being used as a fuel to keep up the heat in the furnaces. The estimated cost of the manufacture is 11s. 3d. per ton, thus:—*Cost of* cutting and drying the peat, 1s. 6d.; carting to works, 6d.; stacking and other expenses, 6d.; cost per ton of peat, 2s. 6d. As it takes three tons of peat to make one of charcoal, the cost of three tons would be, 2s. 6d.=7s. 6d.; cost of charring, 2s. 6d.; landlord's royalty, 3d.; management, &c., 6d.; wear and tear, 6d.=11s. 3d. per ton. The quantity of tar he estimates at 6 per cent, though he has obtained as much as 15 per cent in some cases. He considers that one ton of peat would yield 134 lbs., and 300 tons 40,200 lbs.; and this yields, at 10 lbs. to the gallon, 4020 gallons, which, if sold at 3d. per gallon, would produce £50, 5s; and this sum, when deducted from the cost of obtaining 108 tons of charcoal, at 11s. 3d., say £61, 5s., leaves only £11, as the cost of the 108 tons of charcoal. A ton of peat yields also from 30 to 50 gallons of ammoniacal liquor. The suitability of the charcoal for the purpose for which it is hoped it will be principally applied to in Ireland—namely, the reduction of the iron ores—Mr Hays states he has proved, at the iron and tin-plate works of Mr James Brown, of Abertillery, Monmouth, where, he says, it gave much satisfaction, affording great heat, without the presence of either sulphur or smoke.

Mr Hays' experiments, in compressing peat, have resulted in the production of a material nearly as dense as coal, and which he estimates can be manufactured at 4s. 8d. per ton; exclusive of wear and tear, or interest on money. Dr Letheby, in his report on compressed peat, remarks, that "it appears to possess most of the qualities which are referred to by the Admiralty Commissioners, as the essentials of a good fuel, for it burns quickly, and therefore produces steam in a short time."

Some recent extensive applications of peat to the manufacture of iron on the Continent, have demonstrated that it is superior in many respects to wood, whether charred or not. It is said that the metal obtained and worked by compressed or carbonized peat, not only possesses absolute purity, but it imparts a greater ductility to it, without imparing its tenacity in the smallest degree. It is somewhat remarkable, that notwithstanding the obvious purity and other valuable properties of wood charçoal, it tends rather to harden iron, whilst peat produces almost an opposite effect, and peculiarly adapts it for every description of manipulation; and for which purposes compressed peat, or peat coke, or both combined, would appear to be preferred. At Munich peat is most extensively dried.

A new preparation of peat has just been discovered by a chemist at Cologne. It is denominated "Cialine peat," and is said to excel any other fuel in the intensity of its heat and flame. The experiments hitherto made in forges show that cialine will produce a flame several feet long, while common peat will only give one seven or eight inches long.

M. Busson du Maurier has recently been presented with a "medal of honour" as the inventor of a remarkable process for the carbonization of peat. The novel feature in this process consists in the intimate intermixture of coal dust from pit banks, &c., with powdered peat, by the aid of a machine, and by which means the inventor obtains a coke, or fuel (of which the specific gravity, although a little less than that of the best Newcastle coal-coke) is such as to offer the consistency required to render it fit for all purposes where coke (pure coal) is used, whilst it is applicable to many uses for which that is with difficulty employed. This half mineral, and half vegetable fuel, has been found very valuable for manufacturers of steel, tools, &c., and unquestionably will become a most valuable acquisition in the production of superior iron, &c.,—especially in localities where the refuse coal dust is sufficiently abundant.

As regards the applicability of peat to steam purposes, Mr Jasper Rogers, C.E., founder and patentee of the Irish Amelioration Society, says, "I am satisfied that peat fuel for locomotives, and such special purposes, may be prepared and sold with sufficient profit generally, in Ireland, at 10s. per ton, whilst the average of coal-coke may, I believe, be taken at 45s. *Hence*, 20s. worth will do the work of 45s. worth, and it is clear to me, from experience, that the valves will last much longer with peat fuel than coal-coke." He also—after explaining that if turf fuel is employed in the manufacture of iron, it can be made equal to any imported by us from the north of Europe—thus shows the value of peat charcoal as a fertilizer:—

1. It is a fertilizer of the highest order, possessing the power of taking up eighty per cent of its weight of moisture.

2. It immediately corrects, and perfectly decomposes all putrescent matter.

3. As a fertilizer it yields to the roots of plants carbon in a pure state.

4. It holds moisture until the ground around becomes drier than itself; and when this occurs superabundantly it then becomes a filterer.

He then describes numerous experiments, with the use of peat charcoal on potatoes, cabbage, plants, rhubarb, corn, flowers, &c., which resulted in the most satisfactory success.

In a report delivered to the Irish Peat Company, from Dr Sullivan, we find that on the results of twenty-two days working on 775 tons of peat at the company's works at Kilberry, near Althy, it is ascertained that the operations will cost 6s. 10d. per ton, including labour, re-agents, materials, wear, &c.; and the produce of 755 tons, is—ammonia, £16, 19s. 6d.; *naphtha, £29, 1s. 3d.*; lubricating oil, £290, 12s. 6d.;

light and other oils, £132, 7s. 11d.; paraffine, £96, 17s. 6d.=£505, 18s. 8d. The cost of 775 tons of peat, at 6s. 10d. per ton, amounts to £264, 15s. 10d., leaving a profit of £301, 2s. 10d., or about 7s. 9d. per ton.

It appears that the ammonia is in great demand, and meets with ready sale at full prices; the lubricating oil is much enquired for, and orders are being received for more than the company can produce, at prices considerably higher than were originally estimated; while the paraffine produced is of the finest description for the manufacture of candles of superior quality.

Mr Johnston, and Mr R. A. Brooman, have patented improvements in manufacturing gas from peat, and in treating hydrogen gas in order to render it illuminating. The following is stated as the result of this new illumination in Dublin:—268 jets of gas, representing the word "Peat," were presented in front of the street, showing a soft, permanent, and brilliant light. These jets were fed by gas which burned for more than an hour, consuming in that period but sixpence worth of common turf peat. It appears, that from one pound of turf as much as six cubic feet of gas, of excellent illuminating quality, may be obtained. Good coal produces about the same quantity, and of about equal brilliancy. Coal costs in Athlone from 30s. to 40s. per ton. In the same place, turf may be obtained for about 5s., so that in such a place the cost of peat gas is no less than seventy-five per cent cheaper than coal gas. From four tons of turf, one ton of peat charcoal is obtained as a residual product, worth at present £3. This may be used with great advantage in smelting iron. Two hours is the usual time for working off a charge of gas from coal. The gas may be made in a few minutes from peat turf.

It takes three tons of coke to make a ton of pig, and one and a half tons of charcoal to make a ton of the finest charcoal iron. Sir Robert Kane, a first-rate authority in every thing connected with the natural resources of Ireland, carefully analyzed, and reported to the House of Commons in 1851, on twenty-seven different specimens of peat, from various bogs in the island, with the localities where obtained, and the average depth, which was twenty-one and a half feet. But Messrs Gwynne & Co., basing their calculations in order to be within bounds, on the average depth only of twelve and a half feet, and an extent of bog-land of 2,000,000, instead of 3,000,000 acres, show that the enormous quantity of 6,972,000,000 tons after it shall have been raised and air-dried, may be furnished by the bogs of Ireland alone.

In estimating the value of turf as compared with coal, Mr Mallet, assumes it as nine to fifty-four, or one-sixth, making the turf of Ireland equal to *470,000,000 tons of* coal, worth, at 12s. per ton, upwards of £280,000,000 sterling; but, as Messrs Gwynne compress peat to one third its original bulk after air-drying, and as in all respects, the product may fairly be taken to be equal, if not superior to coal, the value of this production would be £2,788,800,000, representing a quantity equal to 5,648,000,000 tons of coal, in realising which the land would be in time cleared over between 2,000,000 and 3,000,000 acres, of immense value to the agriculturist. The bogs which have been partially cut away in the limestone districts, have proved very valuable as soil for the growth of cerials, &c.; and from the moderately elevated position of the greater part of them, it is said, they can be surface-drained at an expense of about fifteen shillings per acre.

A peat bog, if drained and consolidated, may have its surface irrigated, and produce very good herbage.

The following remarks on the preparation of peat, for the improvement of land, especially of a clayey or chalky nature, are of too much practical value to be passed over in silence. "Peat contains all the elements of the richest manure, and may by an easy process be converted into humus; for this purpose the agency of alkalis is the most effectual. If the tannin be decomposed, that of the vegetable fibre will go on, and soluble humus will be formed. When peat is newly dug up, if caustic lime be added to it *before it is* dry, the moisture of the peat slakes the lime, which acts on the gallic acid in the peat and neutralises it. If this mixture be then excited to fermentation by the addition of animal matter, such as urine or dung, oxygen is absorbed and carbonic acid evolved; and the residue is converted into an excellent manure, containing much soluble humus. The same may be effected more slowly by mixing peat with clay or marl, and allowing the mixture to remain exposed to the atmosphere for a considerable time, frequently turning it. But nothing accelerates this process like the addition of putrescent animal matter, which acts as a ferment and greatly hastens the decomposition.

The experiments of Mr E. W. Davy, prove that peat is greatly superior to peat-charcoal, in manufacturing manures for agricultural purposes. The latter, being found to possess very little power of absorbing and retaining ammonia of excrementitious matter when mixed with it; whereas peat possesses this valuable property in an eminent degree, and absorbes and retains it in a most striking manner. As regards carbonic acid, the great food of plants, peat has also been demonstrated to exercise a decided advantage over peat-charcoal.

Where the conditions are favourable for the reclamation of peat-bogs, and which is believed to be the case with the great majority of those of Ireland, *immense tracts of* productive land might be gained to the country, by marling, and manuring, especially with caustic lime which will soon convert the peaty matter, into a rich soil abounding in humus. By processes of this kind, (with draining of course) a once worthless and dreary peat moss (Chatmos) in Lancashire, has now become a rich and fruitful plain, teeming with cerial burdens—grateful tributes, for the skill and industry bestowed upon it, blessing, like the quality of mercy,

> "Both him that gives, and him that takes."

The foregoing facts, and estimates, not only demonstrate the extraordinary scale on which the peat formation of Ireland is developed, but very forcibly elucidate the immense value and pregnant character of the deposit; second, indeed, only to those kindred, but more perfected magazines of bituminous wealth, so abundantly conservated, in the deep recesses of the earth, by an All-wise and benificent Providence.

The iron ores for smelting,* and the lime as a flux, frequently exist, as, in the course of our investigations, we have endeavoured to show, in almost inexhaustible quantities, within the very precincts of many of the peat-bogs; requiring only the application of skilful and persevering industry to produce a metallic material, which in point of quality, and quantity would become no despisable item in the vast catalogue of her domestic metalliferous productions.

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* See Chapter III.

Science, then, it will be seen, has at length stretched forth her all-potent wand over the cheerless expanse, and the spirit of enterprise, has right-well, responded to the magic touch. Where, all before was barrenness and sterility, pregnant stores of rich and useful products, have already poured forth in copious streams; —*lights* have, literally, arisen from within the dark bosom of the dreary swamp; not the *ignis fatuus*, to which it has hitherto only given birth, to flit about the treacherous surface, and allure the wayfarer to destruction; but, the torch of true enlightenment, destined, alike, to shed a cheering radiance into the remotest corners of the Isle, to scare away the demon of discontent, and, eventually, to illumine the benighted mind. The "rivers of oil" which it is now proved to demonstration, these hitherto unproductive wastes contain, will assuredly, ere long, prove far more effectual, in *healing* the obdurate sores of Old Ireland, than all the panacéa that were ever prescribed by her most devoted, or infatuated demagogues; and a steady perseverance in the varied, wide-spread industrial pursuits, now so auspiciously progressing, will, doubtless, not only bring comfort and plenty, to the miserable hovels of a half-fed peasantry, but in due time, cause even the desert places of this long stricken land, to "*rejoice* and blossom as the rose!"

CHAPTER XII.

CARBONIFEROUS SYSTEM—GEOLOGICAL FORMATIONS OF MEATH, DUBLIN, &C.—CALP LIMESTONE—GEOGNOSTIC STRUCTURE OF THE HILL OF HOWTH—ABUNDANT MINERALS OF CAVAN—COPPER, LEAD, AND OTHER MINES—CALCAREOUS MARL TRACTS—IMMENSITY OF MINERAL FIELD—GREAT LIMESTONE PLAIN—A RETROSPECTIVE GLANCE—MEDITATIVE REMARKS—IRISH WILL WORK—LORD CLARENDON'S TESTIMONY—SALES AND IMPROVEMENTS OF ESTATES—DECREASE OF CRIME—INFLUX OF CAPITAL — CONSTABULARY FORCE — ENCUMBERED ESTATES' COURT—INDEPENDENT MIDDLE CLASSES—FIELD SPORTS—NOBLE FIELD FOR INVESTMENT.

WE now arrive at the last of the metalliferous regions, to be mentioned in this, our discursive and general survey of the often extremely complex and most interesting geological structure of Ireland; and this will bring us to the point, namely, Dublin Bay, on the southern shores of which our physical investigations were commenced.

The Black Calp, or argillaceous limestone, which is the middle rock of the carboniferous system, occupies nearly the whole of the district in question; it constitutes, for the most part, a broad zone, being a part of the great limestone field of Ireland, extending from the vicinity of Longford, in a very tortuous line through *Meath* and the valley of Dublin, to the northern shores of Dublin Bay, and mainly forming, together with the lower limestone, the coast line from thence to Drogheda. From this place to Kells and Granard in the county of Longford, the calp tract is separated from the clay-slate area already described, by a narrow sinuous belt of the lower limestone. The quarries in the neighbourhood of Dublin are in the calp limestone. The dark shaley beds with which it is interstratified, contain nodular clay iron stone, often much impregnated with pyrites,—a combination which gives rise to the many chalybeate, and sulphuretted, springs so common in the calp districts.

The limestone tract we are referring to, reposes to the south on the micaceous and argillaceous schists which flank the granite ranges of Wicklow; and the carboniferous beds, which fringe the primitive series, being highly indurated, and commonly possessing a laminated structure, furnish a very excellent and durable material for architectural purposes. Along the coast line to the north of Dublin Bay, isolated masses of greenstone, quartz, and argillaceous schists occur. The high serrated rocks, forming the peninsula of Howth, are of a varied and interesting character. The Hill of Howth is, for the most part, composed of clay slate and quartz rock, between which irregular masses of an intermediate character are frequently interposed. The south side is chiefly occupied by *porphyritic* greenstone. The floetz limestone, trending through the north-western division of Meath, skirts the silurian slate formations of Cavan, in the eastern part of which county there occurs a patch of granite about seven miles square.

A variety of minerals abound in Cavan. In the Ballynageerah Mountains, there are coal and iron mines, and an extensive bed of blind-coal occurs at a place called Shercock, as also between the towns of Cavan and Virginia. Copper, lead, coarse manganese, and ochre, have been discovered in the east and other parts of the county; fuller's earth, potter's clay, brick clay, and excellent marl, are abundant throughout these central districts. The latter, extends over most parts of the low gravel region where the eskers occur in Longford, and commonly constitutes the surface of the open, well-cultivated country, stretching westward towards the Shannon.

A fine calcareous marl also underlies many of the peat-bogs,—a circumstance which might (by sinking through them to it) be turned to very good account in their reclamation. Tracts of rich vegetable mould, similar to the one which slopes towards the valley of the Juny, may frequently be met with in this and other parts of the floetz-limestone plain of the country, producing either rich feeding pastures, or heavy crops of grain. Some of these lands would appear very nearly to approach in com*position* what is denominated a good soil—par excellence,—which is described as composed of "one-third coarse sand, one-third very fine sand, and one-third impalpable matter, in which there is silica in the greatest quantity, alumina and lime in a smaller, and from four to ten per cent of organic matter, without any appearancc of tannin.

The metalliferous character of the calcareous and other rocks in this part of Ireland will be rendered sufficiently obvious, when we state, that at the present period, in Meath there are at least four mines of copper, one of silver-lead, and one of iron; and two of lead and copper, in the vicinity of Longford; whilst the county of Dublin numbers three of copper, thirteen of lead, three of which produce zinc, one of manganese, and one of lead and tin. The Howth mines consist of lead and manganese. The Seapoint, Lambay Island, and Loughshinny are copper mines. Lead and tin are found near Kingstown; the Thelleystown, Kilmainham, Castlenocht, Ashtown, Cloghran, and Phœnix Park mines consist of lead; argentiferous lead, with zinc and silver, are found at Ballycorus, and lead and zinc at Dolphinsbarn, and Clontarf.

It may here be proper to observe, that our *numerical* account of mines, as being wrought about the present period in the respective counties, is chiefly derived from the official catalogue published by R. Griffith, Esq., a gentleman well known for the accuracy and extent of his practical knowledge of Irish mining and geology. Of course, this list must be considered much below the actual number of mines merely opened or in a preliminary trial-state, and it certainly does not include the untried, but known lodes, and indications of ores not as yet sufficiently tested.

We think it hardly possible for any one who favours with a perusal, the foregoing outline—necessarily cursory, or imperfect though it be,—not to be forcibly impressed with the manifest ore-bearing capabilities of nearly every portion of the country, we have been geologically discanting upon, and, in a limited sense, endeavouring faithfully to portray; and, taken in the aggregate, the *immensity* of the mineral field here open to enterprise, capital, and skill; if so, the great incentive to our present labours will have been happily realized. In fact, the vast majority of the mines opened and in operation, already stud nearly the whole of the maritime districts of Ireland; and when, coupled with this fact, it is considered that its great central plain is composed, as already intimated, of one of the most productive lead-bearing formations in the whole geological series, the carboniferous limestone, there occupying—chiefly in its lower series, —an area of 130 miles long and 120 broad, spreading over 10,000 square miles, or two-thirds of the country, an overwhelming conviction of Ireland's natural resources, in the present view alone, must surely penetrate the most illiberal or prejudiced mind.

But, whilst we have thus been enabled to point with an air of triumphant confidence to the several vast natural repositories of her entombed riches, we trust that we have no less palpably demonstrated how materially the proverbial natural fertility of the "Green Isle" is owing to the pregnant and often happily varied character, of her great geological features, and that in this point of view, also, she possesses all the ready appliances for the easy and effective reclamation of her extensive wastes, and under proper and encouraging auspices, a sure and steady advancement of her agricultural and domestic prosperity.

Yes, and in casting a retrospective glance over the varied lands we have been discoursing upon, whether it be the fertile vales, the wavy plains teeming with their luxuriant crops, the green pastures animated by herds of thriving cattle, the upland slope, or the arid scenes of the Binabola and the Killiries, where frequently the adamantine foundations of Alpine heights appear, as if by some convulsive throes of nature, to have been hurled forth and scattered abroad in wild and magnificent confusion, and where, too, we may freely contemplate many a latent wonder of the mineral kingdom, in the beauteous structure, and economy, of the glittering piles which constitute, the vast *framework of the globe*—on every hand, are we reminded, that a bountiful Providence has most superabundantly treasured up, even within the compass of this verdant Isle, the grand elements of progress, success, and power; and it is for us to employ ourselves in the diligent and honourable exercise of that superior knowledge, and of those wonder-working appliances, we have now so greatly at command, in discovering, effectively developing, and diffusing these great and "good gifts" towards the advancement and spread of civilization, the emancipation of the "poor and needy" from the trammels of a debasing poverty, and last, though not least, to the honour and stability of our great and favoured nation.

The study of geognosy has already, as with a magician's wand, brought forth—from that chaos of undigested and heterogeneous materials, but of late, so generally supposed to constitute the structure of the earth—a beautiful and systematic arrangement of indigenous formations, which not only constitute the bones and sinews of her strength, but are the capacious repositories of those varied mineral treasures, to which we owe our national prosperity and pre-eminent position amongst the nations of the world. Their actual interior constitution, crystalline, metallic, and economic elaborations are, as yet, comparatively but little known to us; the great arteries and veins we have mainly been descanting upon are, however, we *may rest* assured, so introduced into the general organization of the mighty fabric, as, like the blood courses of the human system, to form an essential part of the *perfect whole;* they abound in pregnant riches, and are duly furnished with infallible indications; for nature is no niggard, nor is she, when rightly understood, a deceiver. Her fair temple is the handywork of consummate wisdom and benevolence; and if the road to it *is* strewn with difficulties, and oftimes proves a devious maze of bewilderment, it was wisely so ordained, because it is required of man to exercise his perseverance, industry, and skill, in order to acquire knowledge, to rise to eminence, or to achieve any very great or essential good. From the cradle to the grave, man's mental development, is truly said to be progressive, and nature performs not her magnificent *material creations*, by convulsive fits and starts; on the contrary, all her works palpably demonstrate to our senses that they are, as it were, infinitesimally, gradually, and imperceptibly elaborated, till the destined ends are attained, and the created object comes forth, an emblem of mystery, but clothed with perfection. And, as man, by his labour, continues to initiate himself in these mundane secrets, fresh floods of light will illumine his path, and at every step he will behold new and marvellous instances of the power, wisdom, and goodness, of the Great Architect,—the "Giver of every good and perfect gift."

Of all the industrial resources which nature has heaped upon Ireland, it has been remarked, that *limestone* and *labour* are the most abundant; so little, however, has been done by the hand of man to use and improve her teeming gifts, that it has become a national reproach, and not a few, and indeed, too often those whose responsibilities of station make them desirous of shifting the burden of the onus off their own shoulders upon those of the weak, have very mercilessly branded poor Pat, as a worthless specimen of humanity who prefers starvation to work. A charge against which, from experience, the writer of these pages is happy to be able to enter his individual protest, having for many years been in the habit of employing Irishmen on his own property in England, in agricultural labour of various kinds, occasionally retaining the services of the same parties the whole year round, and has always found them faithfully and industriously respond to a little encouragement and proper treatment.

It is highly satisfactory to be able to introduce here, an extract from a letter from so influential a personage as Lord Clarendon, corroborative of this testimony. "It is a mistake," says his Lordship, "to suppose that the Irish people will not work. They are both willing and desirous to work, and when in regular employment are always peaceable and orderly; and as they have lost their confidence in *the potatoes*, there will not be the same difficulty, as in former times, in inducing the occupant of three or four acres of land to become a labourer for money wages punctually paid; on the contrary, there is every reason to think that they would greatly prefer it. I may add, too, that the tenant-farmers now no longer adhere to their old and vicious system of cultivation, but are eager to learn, and are grateful for instruction. In short, from a concurrence of circumstances, I do not think there is any country in the world where change would be so beneficially and speedily effected as in Ireland, by the judicious application of capital; while ordinary attention to the comforts of the people, and the improvement of their habits, would produce contentment and confidence, and render the appeals of selfish agitators innocuous."

In the north of Ireland, wages of labourers at present are at the rate of from 1s. 6d. to 1s. 8d. per diem, and for a pair of horses 9s. a day. In the south, a man with a pair of horses and plough receives 11s. a day; labourers 2s. 6d.; and women from 1s. to 1s. 3d. per diem.

In 1850 and 1851, the counties of Mayo and Galway were the most hopelessly involved, and uncivilized districts of Ireland. Now, from the first sale under the commission, an interval of five years, 550,000 acres, equal to one-fifth of the whole available superficies of these two counties, have been sold in *lots to solvent* purchasers, for a total amount of about £1,500,000; one-third of the purchasers are English and Scotch. The report of the commissioners of public works, issued in 1854, show that, under the Land Improvement Acts, no less than 153,160 acres had been thoroughly drained up to that time, at an average cost of £4, 10s. per acre; and that, of this vast extent, 7500 acres were completed during last year. Returns made to Parliament show that the average acreable rate of purchase under the Encumbered Estates Court in Ireland, making allowance for town sales, has not much exceeded £6 per acre. But in any case, says a very competent authority, it must be recollected, that to buy Irish property—*we must buy to improve it*, and for which the natural capabilities of the land offer every encouragement. "The Board of Works is prepared to advance money for improvements in draining, farm-buildings, road-making, trenching, fences, and liming the land, and in some cases irrigation—the loan being repayable in twenty-one years, at the rate of six and a half per cent per annum, which in that time repays both capital and interest."

During the last few years, crime has been greatly on the decrease in Ireland. The year 1850 compared with 1849, showed a decrease in the number charged with offences before the Tribunals of Assizes and Quarter Sessions, of 10,663; 1851 compared with 1850, had a decrease of 6,642; and in 1852 compared with 1851, showed a further decrease of 7,006, being a total decrease in the three years of 24,311. The decrease being found to exist not only in every class of offences, but in every province.

Indeed, ever since 1849 especially, the condition of Ireland has been improving; and the maximum of the poor relieved in 1855 was 99.627, or 1-10th of the number relieved in 1849. "There was in 1855," says the Poor-law Commissioners in the eighth report, "continuous employment, with wages at 1s. per day, where formerly the rate was 4d." The great destitution of the Irish in 1849 explains the incessant diminution of committals. The decline being from 41,989 committals in 1849 to 9,012 in 1855; consecutively—a large fall year by year.

After a brief reference to the social state of Ireland some ten years back, the *Banner of Ulster* describes the position and prospects of the country in 1857 in the following terms:—"We hear much of the difficulty of procuring hands at out-door labour, and those whose vocation it is to grumble, wax eloquent in describing the great scarcity of workpeople; but who that recollects the melancholy state of things in Ireland ten years ago will not sing of Fifty-seven? On the 1st of January 1849, there were 620,000 paupers in all the union workhouses and on the books of out-door relief. On the same date of the present year, Ireland's *pauper* population was only about 65,000, or say one pauper to every hundred of the population. Surely the Saxon as well as the Celt should exult in this, the greatest miracle of modern days, that Ireland is fast becoming one of the least pauperised countries in Europe."

These highly satisfactory results may, doubtless, be mainly traced to the total cessation of political excitement, the voluntary expatriation of the disaffected, &c., and to the vastly increased demand for labour, and rise of wages, consequent on the improved state of the country, and rapidly increasing influx of capital, for the working of mines, quarries, and gradual renovation, and furnishing, of extensive landed properties. And thus, indeed, the cause of order in Ireland, may be truly said to be daily gaining new accessions of pregnant strength and wholesome energy. And if anything else were still wanting to remove the lingering and erroneous prejudices, which people in England very generally entertain as to the insecurity of life and property in Ireland, surely it will suffice to state that an admirably organised constabulary is appointed, consisting of an inspector-general, two deputy inspectors-general, and a most efficient and well-distributed body of horse and foot constables, making in all an effective body of 12,000 men.

The successful working of the Encumbered Estates *Court, especially*, is rapidly infusing a new element of order and progress into the social constitution of Ireland. About ten months ago, it was calculated, that during the then past five years, the sales in the court amounted to £28,065,536; and about a year earlier, it was estimated that in three years and nine months, over 1,500,000 acres had changed hands—4200 solvent proprietors having taken the place of something over 1000 of the former encumbered owners; and of those new proprietors 2718 are of the class of respectable farmers, who purchased up to £2000. And thus, is being supplied Ireland's great want of *independent middle classes*—the acknowledged bulwark and glory of Old England.

The country gentleman, or any one attached to the sports of the field, will find ample scope here for indulgence in such favourite pastimes, whether it be in the use of the gun, the fishing rod, or the hunter. Grouse abounds in most of the mountain ranges, and much of the lower country affords good partridge-shooting, with hares, occasionally pretty plentiful; water-fowl is abundant in river, lough, and estuary; with fish in them everywhere to satisfy the most inveterate of piscators; and as to the glorious sport of fox-hunting—our very pen, as it traces the fascinating word, becomes tremulous with fond recollections of the days of yore—there is no lack of a sure find, and a good burst, across a fine open country in Ireland, *especially in Meath,* Waterford, Kildare, Kilkenny, and Duhallow in Cork, and moreover, at half the expense required for a winter's hunting campaign in England.

Though our expositions of the natural treasures, and amenities, so profusely possessed by this "First Gem of the Sea," have necessarily been of a restricted character, we trust they may prove sufficiently tempting to capitalists, not only to become proprietors, but residents. The tide of speculative enterprise has already set fairly in; and as we behold it increase in strength and volume, bearing up in its welcome progress *many a stranded ark*, destined ere long to ride triumphantly in the haven of genial peace and prosperity, our uppermost and ever-recurring thought is, that the searching and indomitable spirit of adventure, which characterises the British nation, and which so practically manifests itself in every region of the globe, has not, long ere this, availed itself of the substantial allurements of this noble Hibernian field for investment—lying, as it were, fallow, for centuries, at the very gates of Britain!

CHAPTER XIII.

CLIMATE — MOUNTAIN BARRIERS — TEMPERATURE — ELEVATION — DISTRIBUTION OF TEMPERATURE — ALPINE RANGES — SOUTH OF EUROPE — VENT DE BISE — VICISSITUDES OF TEMPERATURE — COMPARATIVE ESTIMATE OF THE SALUBRITY OF THE BRITISH ISLES, AND THE CONTINENT — TOPOGRAPHICAL PECULIARITIES — HUMIDITY — DRAINAGE AND PLANTING — ABSORBENT SOILS, &c. — WINDS — RAIN — COMPARATIVE ESTIMATES — INFLUENCE OF TEMPERATURE — CLIMATIC QUALITIES FAVOURABLY EXEMPLIFIED.

THE natural configuration of the surface of Ireland is obviously fraught with very considerable CLIMATIC advantages. A very large proportion of the most lofty of the mountain ranges are situated near the coast, and moreover, so topographically disposed, as to constitute very effectual barriers against the more boisterous and searching winds; whilst to the southward, their comparative absence gives free admission to the genial currents of air from intertropical seas. Thus, the great central plain, and several other extensive districts of the interior, derive from these general physical causes alone, very important ameliorations of temperature, and unquestionably, they greatly conduce to that exuberancy of vegetation which is so remarkable a feature, in the natural economy of the *island.*

The mean temperature of Ireland is about forty-nine degrees Fah. In summer it rarely exceeds seventy-nine degrees in the shade; averaging in that season from seventy to seventy-five degrees. The winter or minimum temperature is stated at twenty-six degrees; between these limits the temperature oscillates, but is found equal at two periods of the year—April and October. The mean temperature of the country, as above stated, is given, as taken at sea level, and of course diminishes according to the height attained above it—the ascertained ratio being one degree in every 510 feet of elevation. By a reference to the tabular statement of vertical heights inserted in the following chapter, it will be seen that the temperature of Ireland, is not subject to any very marked diminution, from the character of its elevated regions; the general surface of the country, too, lying at a very moderate height above the level of the sea.

Although, from its insular position, the climate of Ireland is, necessarily, considerably affected by the mutable influences of the Atlantic, it is not characterised by any injurious or *sudden vicissitudes* of temperature; but, on the contrary, it would appear that a mean of the coldest and hottest months of the year, rarely varies more than ten degrees from the standard heat of Dublin. Being, in fact, an equability *so favourably* distributed through the four seasons of the year, that its genial influences are rendered peculiarly manifest in the verdant and often luxuriant appearance of the natural herbage throughout the year. Effects, which in all probability, may be mainly ascribed to the absence of any very lofty ranges of mountains, as above intimated, and, that but a small portion of the island is more than fifty miles distant from the sea, the salubrious, and modifying effects of which, are doubtless, very considerably enhanced here by the great gulph stream, whose tepid waters flowing northward from tropical seas, bathe the shores of the British Isles.

As to the peculiar tendency of very high mountains, to affect seriously the climate of places in their more immediate neighbourhoods, we need only advert, for a moment, to the extreme vicissitudes of temperature characterising countries bordering on the Alpine ranges of southern Europe. Even, at the far-famed Nice, and other places bordering the Mediterranean enjoying a high reputation for their climatic qualities, we have frequently witnessed, the most extraordinary visitations of boisterous, piercing winds, and sudden changes of temperature; these dry, searching gales usually commence about Christmas, and generally rage unintermittingly for periods of three, six, or nine days' duration. They are succeeded in March and April by winds of considerable force and keenness, from the *east and north-east*, commonly accompanied with a cloudy state of the atmosphere, and occasionally much rain. These winds, and the *Vent de Bise*, as the former is termed, prove most injurious, in their baneful effects, to consumptive invalids, who so numerously resort to these southern climes, in search of health, even from our own country; and, as Dr Farr observes, even the strong feel and acknowledge their evil tendency.

In further illustration of such continental, *excessive vicissitudes of temperature*, we may adduce the following comparative data, from a high authority :—"The mean winter temperature of Province is 43 degrees, being 1½ degrees above the south-west of France, and 2 degrees below Italy. The temperature is distributed very unequally through the year; the difference of the mean of the warmest and the coldest months being 35 degrees. This, in the south-west of England, is 22 degrees; in the south-west of France, 30 degrees; and in Italy 32 degrees. So that the British Isles may certainly boast of a more equable range of temperature than is enjoyed beneath the fervid suns of the south of Europe.

But, such comparative climatic estimates, are still more strikingly displayed by the Registrar-General's recent Quarterly Report; and which appears to prove to demonstration that England is the healthiest country in Europe. France stands next to Britain in *salubrity*. In the continental cities, the annual rate of mortality is seldom less than 30 in 1000; and the rate frequently rises to 40 in 1000. In London the rate of mortality is 25 in 1000. On an average of ten years (1841–50), the mortality was at the annual rate per 1000 of 15 in 3 English districts, 16 in 14 districts, 17 in 47 districts, and 18 in 87 districts. These facts prove that the climate of England is eminently salubrious; and it has not yet been shown that the climate of any part of the Continent is equal to, or more salubrious than the British Isles, crowned with hills of moderate elevation, sloping towards the east and south, bathed by the showers of the Atlantic, drained naturally by rivers running short courses to the sea, cultivated more extensively than any other lands, and producing those unequalled breeds of sheep, cattle, and horses, which flourish only in healthy places. The healthiest parts of our own favoured Isles are not yet places of general resort.

Although, perhaps, it may not be a very difficult matter to convey a tolerably correct idea of the prevailing climatic characteristics of a country or region, such descriptions, can do little or no justice to the atmospheric amenities, &c., of numbers, of its particular localities, or even districts, the climates of which, may be almost entirely characterised by their topographical peculiarities, such as the degree of elevation, nature of the soil, position of a hill, a mountain range, wood, or *forest, state* of humidity, and other appreciable circumstances. A happy combination of some such physical *agreméns*, has, for instance, entitled Rosstrevor to be designated the Montpellier of Ireland, and it will be no deterioration of the compliment, to declare, as we can from actual experience, that in point of *equability* of temperature, it is superior to the far-famed Montpellier of France.

The greatest drawback, perhaps, to the climate of Ireland, is its humidity; the superabundance of which in the atmosphere is, however, eventually destined to vanish, in a very sensible degree at least, before the march of rural improvements. The reclamation of its boggy wastes, thorough drainage, belting and clumping open areas with plantations, and causing umbrageous shades, once again to grace the mountain brow, are unquestionably, the prime remedies for this evil, as indeed they would very effectively prove, to the more formidable ones, both moral and physical, under which the well-stored Isle has long so notoriously groaned.

The moisture, with which the atmosphere is here frequently surcharged, does not in any very sensible degree detract from the natural salubrity of the climate; its injurious effects are greatly neutralized by the open campaign character of the country, and the absorbent nature of most of the soils and substrata, as is more particularly the case with the great central undulating limestone plain, occupying an elevation of about two *hundred* and seventy feet above sea level, where occasionally, the free circulation of the aerial currents soon disperse the watery vapours, carry off the unwholesome exhalations of swampy grounds or stagnant waters, and by amalgamating together the heterogeneous ingredients of the atmosphere, afford no facilities for the collection of baneful or *miasmatic vapour.*

The west, south-west, and south winds prevail during the greater portion of the year, and though they bring with them the aqueous vapour of the ocean, exert on the whole, a very genial influence on the temperature of the island, being usually accompanied by a mild state of the atmosphere. Northerly and easterly winds predominate in winter and spring. Snow-storms are of rare occurrence. On an average, (yearly) wet days exceed the fine ones by about sixty in number. The average fall of rain throughout the country is about 35 inches; in Dublin, 23 to 24; Belfast, 25 to 26; Cork, 34 to 35. The mountainous parts of Galway and coast of Clare, 60 to 61—whilst in London 23 inches yearly falls; Dover, 37 to 38; Plymouth, 35 to 36; Liverpool, 30 to 31; Keswick, 70 to 80; Chltenham 34 to 35 inches.

Dr Romney Robinson estimates the comparative heat of several seasons in London and Dublin, as follows:—

	London.	Dublin.		London.	Dublin.
Winter	1.00	1.45	Summer	5.00	4.68
Spring	*3.00*	2.14	Autumn	3.00	3.80

The foregoing observations, we need hardly say, are, for the most part, but exemplifications of the facts, that "the nature of the soil, the prevailing winds, the quantity of moisture, the electrical state of the atmosphere, and the physical character of the adjacent countries and seas, all modify the temperature which would be due to latitude and elevation."

Even as the influence of temperature in the living body is indicated more accurately by our sensation than by the thermometer, so does the growth and appearances manifested by vegetable life, demonstrate, at a glance, as it were, the prevailing characteristics of a climate, more effectively than ascertained thermometric results; and no one, we think, with the knowledge of this fact in his mind, on surveying the remarkable luxuriance of the greater portion of the country under review, can help being impressed with a very favourable opinion of its climatic qualities; more especially we point to such striking criteria, as redundantly display themselves in the far stretching fattening pasture-lands of Meath, in the rich undulating plains and charmingly diversified demesnes of Westmeath, and amid the exuberant, varied, and glowing landscapes which so remarkably grace the environs, of the beautiful city of Dublin.

CHAPTER XIV.

WATER POWER—VARIOUS ESTIMATES OF PARAMOUNT IMPORTANCE—INTERCOMMUNICATION, ROADS, RAILWAYS, &C.—LOUGHS CARRIB AND MASK—IRELAND IN OLDEN TIMES—A MODERN PICTURE OF ERIN—PAST DISASTERS, DISAFFECTION, &C.—A BRIGHTER ERA—THE EXODUS—INFLUX OF ENGLISH VISITORS, &C.—ACCELERATED INTERCOURSE—SAXON AND CELTIC ADVANCEMENT—UNANIMITY.

THE water power of Ireland is too important a feature to be passed over in silence; in the development of her mineral treasures, and in its general adaptation to rural pursuits and improvements, especially, its advantages cannot be too highly estimated. And it would be impossible for us to represent the subject more effectively than by adopting the lucid explanations of Sir R. Kane:—

"In the total area of Ireland, put at 32.509⅝ square miles, it is found that there are—

Between sea level and 250 feet of vertical height	13.242¾
Between 250 and 500 feet of height	11.797⅛
Between 500 and 1000 feet of height	5.797⅞
Between 1000 and 2000 feet of height	1.589⅝
Between 2000 and vertical height	82¼

"If then we consider the average elevation of these zones to be the arithmetic mean of the extremes, the average of the last term being 2500—which, if not absolutely true, cannot be far from the truth—the result is, that the surface of Ireland is, in average, elevated above the level of the sea, 387 feet; the water, consequently, which flows in our rivers to the sea, has an average fall of 129 yards; while, finally, we may calculate the total water-power of Ireland to be had, for the total quantity of rain falling in a year, 100,712,031,640 cubic yards. Of this, one-third flows into the sea—that is, 33,237,343,880 cubic yards, or, for each day, in twenty-fours, 91,061,216 cubic yards, weighing 68,467,100 tons. This weight falls from 129 yards, and as 884 tons fall twenty-four feet in twenty-four hours, we so possess, distributed over the surface of Ireland, a water-power capable of acting night and day, without interruption, from the beginning to the end of the year, and estimated at a force of 3227 horse-power per foot of fall, or, for the entire average, a fall of 387 feet, amounting to 1,248,849 horse-power. Mechanical power, however, is never thus unintermittingly driven. If then we reduce this force to the year's work of 300 working days of twelve hours each, we find it to represent 3,038,865 horse-power—that is, more than 3,000,000 of horse-power.

"Of course, though much of this enormous quantity of force exists in localities where other circumstances *may* prevent its becoming useful, or the perfect *economy* of the water for mechanical power may be inconsistent with other equally important objects—as, for instance, the drainage of districts for agricultural purposes, or the maintenance of navigations, may require constant discharge and loss of a certain quantity, —the different water machines, again, incur as continual a discharge and working, which may be estimated at about one-third; still, I consider the amount of mechanical force altogether derivable from the water power of Ireland as of the highest importance, and worthy of far more attention than it has hitherto received, as one means for applying the resources of the country."

As to the means of intercommunication, Ireland abounds in excellent roads, and the rapid progress of the railway system will before long render it, even to the remotest parts of the island, all that can be desired. They already afford easy access to some of the most remote and interesting districts of the Island. The Dublin and Belfast junction, traversing the maritime counties of Dublin, Meath, Louth, and Down, opens up a long succession of pleasingly diversified coast scenery with fine views of the Irish Sea; diverging from which, it enters, beyond Dundalk, the romantic and picturesque region of the Mourne Mountains; and after affording many charming peeps into the deep and often fertile valleys at their base, sweeps through the pleasant vale of the Lagan to Belfast, *so justly* designated the first town and second port in Ireland for trade. From this latter portion of the route, the glittering expanse of Lough Neagh, may be seen at a short distance, like an inland sea; whilst on every hand are displayed the rich undulating pasture and corn tracts, wooded demesnēs, and numerous towns and villages, so characteristic of the county of Down. Tourists from Dublin, &c., may now very economically and expeditiously visit the remarkable and splendid scenery of the Giant's Causeway by this agreeable line; and for which purpose, arrangements, during the summer and autumn, are specially and exclusively entered into by railway companies, on both sides of the channel.

The Dundalk and Castle Blayney Railway will ere long be continued to Enniskillen, a busy and thriving town, beautifully situated between the upper and lower lakes of Lough Erne,—the Windermere of Ireland; the lower lake is about fifteen miles in length, and varies from five to two miles in breadth, and is studded with one hundred and nine Islets. A railway is now open from Enniskillen to the city of Londonderry; affording also ready access to the remote county of Donegal.

The highly interesting and romantic region, comprising Connemara and the West is now easily reached, by the Midland and Great Western Railway from Dublin to Galway; and from thence, a stage-car daily *runs to* Clifden, and which, after traversing a district incomparably wild and beautiful, lands the tourist amidst scenery which it is no exaggeration to say is "almost worthy of Switzerland." The line is 124½ miles in length, and traverses the several counties of Dublin, Kildare, Meath, Westmeath, Roscommon, and Galway. In a commercial point of view it is of vast importance to the country, opening up as it does, the great agricultural district surrounding Mullingar, the important town and neighbourhood of Athlone, and securing the most obvious advantages to the wild, but eminently reclaimable, and now rapidly improving region of the west, with its inexhaustible stores of peat-turf and various rich mineral productions.

The Great Southern and Western Railway, already enjoys the reputation of being one of the best paying lines in the kingdom; its entire length from Dublin to Cork is 165 miles, running through the counties of Kildare, Queen's County, Tipperary, Limerick, and Cork; it thus traverses some of the finest and most interesting portions of Ireland, comprising the fertile valleys of Leinster and Munster. This important line is joined by,—or intersects, the Carlow branch extending to Kilkenny and Waterford, Killarney junction, and Cork and Bandon; other extensions being already projected or in course of construction. Every facility and encouragement, is thus, therefore, being afforded to the full development, not only of the *agricultural* capabilities of the south and south-western provinces; but to that of their splendid stores of mineral wealth especially, as existing in the coal-fields of Leinster and Munster, and the copper, lead, and other mineral deposits for which the southern maritime districts are becoming so justly celebrated.

And we may rest assured, that ere many years have elapsed, the moral, humanizing influences, of these mighty engines of civilization, will be seen manifesting themselves, throughout the length and breadth of this favoured land, in the tangible, and pleasant objects, of well cultivated fields, neat hamlets, smiling (not deserted) villages, and flourishing towns and cities.

Remarkable natural facilities for transit, are afforded by the deep and capacious bays and inlets which cleave and indent its coasts; the canals, and the extensive and beautiful loughs which here and there diversify the interior, and of which Lough Corrib and Lough Mask are splendid examples; they are separated by a narrow neck of land, about two miles in breadth, through which a canal is now being cut, and when completed, these two magnificent expanses of water, will open out a still-water navigation of over forty miles in length, presenting a coast of upwards of one hundred miles, skirting vast ranges of the glorious mountain scenery, and prolific mineral districts of Galway and Connemara, even into the county of *Mayo; in* short, it is affirmed that there is no point on the surface of the island more than twenty-five miles distant from the sea, or from a navigable lake or a river.

Such, then, are the singularly redundant natural resources and advantages possessed by the Sister Isle; and in closing our descriptive remarks thereon, it affords us some additional satisfaction, to show that so remotely as 1596, they elicited the meed of praise from a writer of that period, Mr Edmund Spencer, who, in his " View of Ireland," thus characteristically expresses himself:—" And sure it is yet a most beautiful and sweet country as any is under heaven; being stored throughout with many goodly rivers, replenished with all sorts of fish most abundantly; sprinkled with many very sweet islands and goodly lakes, like little inland seas, that will carry even ships upon their waters; adorned with goodly woods, even fit for building of houses and ships, so commodiously, as that if some princes in the world had them, they would soon hope to be lords of all the seas, and ere long of all the world; also full of very good ports and havens opening upon England, as inviting us to come unto them, to see what excellent commodities that country can afford; besides the soil itself most fertile, fit to yield all kind of fruit that shall be committed thereunto. And lastly, the heavens most mild and temperate, though somewhat more moist in the *parts towards the west.*"

To this quaint, but obviously just panegyric, we cannot refrain from adducing another, from a living author, who, in the course of some powerful and eloquent disquisitions, on the present state and prospects of his own native Isle, earnestly exclaims:—"If we turn to the climate, Heaven never blessed a land with more genial skies. Its temperature rarely falls below thirty degrees, or rises above seventy-five degrees; and thus it is preserved, alike from the rigours of northern, and the burning heats of southern climes. Its atmosphere is peculiarly free from disease, and altogether so pure, that, till reduced by late hardships, its people were proverbially healthy; and so mild are the winter months of the south particularly, that the invalid takes shelter in its coves from the less kindly airs of Scotland and Ulster. If you look to the soil, it is provorbially fertile. Its fields wave with the finest harvests. Its very mountains are verdure to their summits. Notwithstanding its vast tracts of waste land, and the wretched cultivation of much that is reclaimed, Ireland exports twice as much provisions as it retains for its own population. The mere trade in its agricultural produce employs a fleet of steamers most part of the year; and you can scarce sit down to a table in Great Britain, on which you will not find the produce of its soil.

"Nor is it less bountifully provided with other elements of wealth. It is intersected by the finest rivers. Its bowels teem with the richest minerals. Its coasts swarm with shoals of fish. It contains some of the best harbours in the world; and such are its engineering facilities, that there is scarcely a tunnel in all its railways. While, as to still higher commercial advantages, it stands out on the world's highway—the Atlantic—with the fleets of nations daily passing by; and between the Old World and the New, as though designed to be their link of communication, and enjoy the blessings of both." *

But alas! with all these multifarious gifts of beneficent Nature, thus scattered around, these teeming and pregnant appliances filling Erin's cornucopia to overflowing, what a sad, what an anomalous spectacle has Ireland, for centuries, presented to the world! Poverty, destitution, agrarian outrage of the darkest dye; landlords wringing the last shilling from a starving tenantry, and flying for security and peace to distant lands; whilst the demon of discontent brooded over her cities and towns, religious and political strifes were rampant, and the fiercest spirit of partisanship cast abroad its firebands at random, spreading dismay and confusion throughout the social hive; thus, as years rolled on, "darkness covered the land, and gross darkness the people;" to the social blight, succeeded a physical blight, the favourite food of the people was everywhere smitten, and pestilence and

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* *Rev.* Edward Marcus Dill, A.M., M.D.

death, stalked through the land ; subsequently, tens of thousands of the survivors, as though instigated by one common impulse, fled from their native shores for ever, but, under the merciful guidance of a mysterious Providence, found a home, perhaps a Canaan, beyond the broad Atlantic.

Who, seriously contemplating this strange and harrowing, but true picture of the past, can, at the present gladdened and peaceful period, doubt the truth of our intimation in the outset, that the sun of Ireland's prosperity and happiness had now assuredly arisen on the Isle, with "healing in its wings?" The astounding extent of the "exodus" had hardly been announced to the world, when it became pretty obvious to all, that the dread climax had passed away, and that a better order of things had began to prevail.

The tourist, the man of business, and the capitalist, of Britain, to whom Ireland, save by report, was but a *terra incognita*, have of late flocked to its shores, and finding it a land "whose stones are iron, and out of whose hills thou mayest dig brass"—"a land of brooks of water, of fountains and depths that spring out of valleys and hills ;" they have returned home with the goodly tidings on their lips, and the welcome avowal that Ireland and the Irish have been much misrepresented. Confidence has become established, and *capital* is already rapidly following confidence, and is *now being* so very generally invested in Irish enterprises. The ownership of the soil, as we have seen, is fast changing hands; and a new and unencumbered succeeding the old encumbered Proprietary; already indeed, nearly eleven hundred insolvent landlords, have sold their estates, one-twelfth of the area of Ireland, has changed owners, and more than ten millions of capital, have been invested in the purchase of property, from the Encumbered Estates' Court.

With an energy and a spirit worthy of these stirring and eventful times, the various material resources of the country are already in a new and hopeful course of extensive and important development. The mines and quarries alone, already give employment to many thousands of persons, and the surplus labour is being rapidly absorbed by the new works which are gradually starting into existence, even to the remotest corners of the island; in the far-off, and all but depopulated wilds of Kerry, and in the solitudes of Connemara and Donegal, the busy hum of industry is heard in the hills, and the sound of the anvil resounds through their vales.

This unwonted gleam of prosperity, would seem already, to have new strung the energies of a naturally warm-hearted, clever, and impulsive people; and it is earnestly to be desired, that an accelerated intercourse between the two countries, will continue to *foster and incite* this onward career; to obliviate all narrow-minded, national, and party prejudices, and to engender a liberal spirit, and an universal desire for intellectual enlightment, till the Celt, in every essential sense of the word, is anxious and emulous to go hand in hand with Saxon advancement. That, in heart and verity, we may be one people, as we are the subjects of one Sovereign, and are all the children of one Common Parent—even of Him who hath "garnished the Isles," and sent forth "His word for the good of His people," and, on the due appreciation and following of which, alike depend, personal happiness, and national prosperity.

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